Model 524B-40751-030-0-70
Solid State Digital Setpoint Controller
Husky Mfg. and Tool Works, Ltd.

Number	Section	Name
1252 IN 34 cover sheet	1	Description, Specification, and Operation Installation and Wiring
F-14851	3	Main Board
F-16199	5	Troubleshooting
F-15083	7	Circuit Description and Service Control Mode Board
F-15082	8	Circuit Description and Service Output Board

1.1 Description

These controllers have solid state switching outputs capable of 10 Amperes Inrush, 1 Ampere Continuous, and 50 mA minimum. Any voltage from 24 VAC to 240 VAC can be switched. Electromechanical contactors or the Barber-Colman Series CB11 and CB13 Solid State Contactors can be switched. The time proportioning switching output's cycle time can be adjusted from 0.6 to 6 seconds by means of the front panel CYCLE control. Units shipped from the factory are set at 3 seconds.

The series 520 is a modular controller designed for minimum down time by allowing quick replacement of either the controller or one of its modules. It will accept the output of a Type J (Iron/Constantan) thermocouple, which is monitored by a Process Meter calibrated to the instrument span.

The front panel digital setpoint has three thumbwheels for selecting the desired control point to 1 degree resolution.

This controller has Proportional (GAIN) plus Integral (RESET) plus Derivative (RATE) control modes. Reset Windup Inhibition is included to control overshoot by inhibiting Reset action during warmup time.

GAIN is adjustable from 1 to 100 (Proportional Band from 100 to (percent)

RESET is fixed at 0.07 repeats per minute.

RATE is fixed at 2.7 minutes.

1.2 SPECIFICATIONS

Reference Accuracy ±0.5% of span.

Reference Operating Conditions

Ambient Temperature: 75°F.

Operating Power Supply: 120 or 240 Vac, ±1%, 50 or 60 Hz.

Source Resistance (TC ranges only): 10 ohms.

Rated Accuracy ±(1% of span plus 0.5% of suppression).

Rated Operating Conditions

Ambient Temperature: 40°F to 130°F.

Operating Power Supply: 120 or 240 Vac, ±10%, at 60 Hz, or 110 or 220 Vac, ±10%, at 50 Hz, by terminal selection.

Humidity: 0–70% RH.

Position (tilt): any position.

Common Mode Rejection: 140 decibel.

Maximum Common Mode Voltage: 120 Vac rms.

Series Mode Rejection: 70 decibel.

Maximum Series Mode Voltage: 5X span.

Source Resistance (TC ranges only): 0–200 ohms.

Extreme Operating Conditions

Ambient Temperature: 0°F to 150°F.

Operating Power Supply: Nominal Line Voltage ±15%.

Humidity: 0–90% RH.

Storing Temperature −40°F to +150°F.

Frequency Response Direct current to 0.7 Hz in the proportional action only controllers. Depends on setting of RESET control in Proportional plus Integral Action Controllers.

Line Voltage Stability 10% change in line voltage will not shift control by more than 0.1% of span.

Temperature Stability

4 microvolts per °F, maximum.

2 microvolts per °F, typical.

Sensitivity 0.00075% of span for 100% change in output.

Isolation Fully Isolated.

Power Consumption 7 VA.

Shipping Weight 4 pounds (no housing).

1.3 OPERATION

1.3.1 Front Panel Controls and Indicators

SETPOINT ADJUST Control for selecting the nominal setpoint temperature.

Amber Lamp Located on left side of upper front panel. Glows when the output switch is on.

1.3.2 Preliminary Adjustments

It may be necessary to operate the process equipment to make preliminary adjustments on it and also, for example, to dry out furnace liner material. During any preliminary operation, turn the RESET control off. Set the GAIN control fully CCW. Now adjust the Setpoint control as desired.

Always make a permanent record of any final settings for a specific process so that if the controls are changed for any reason, the original settings can be duplicated. Upsets can be simulated by turning the Setpoint control to different settings with the degree of upset desired proportional to the change in setting. Allow enough time, when making adjustments, for the system to stabilize. Remember that optimum controller adjustments are those that produce satisfactory results in a stable system. Optimum adjustments are not necessarily the finest and most sensitive settings that can be obtained.

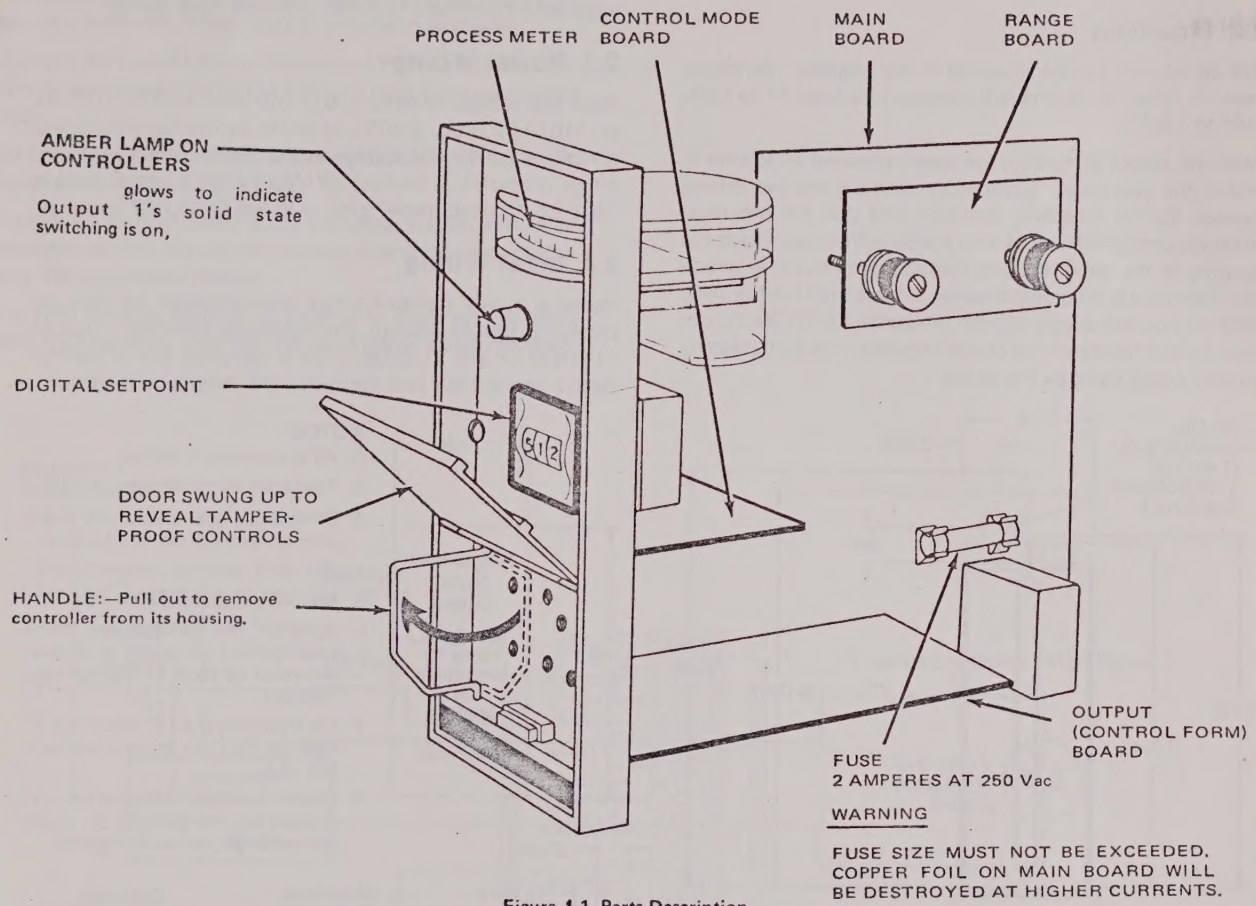

PROCESS METER
CONTROL MODE BOARD
MAIN BOARD
RANGE BOARD
AMBER LAMP ON CONTROLLERS
glows to indicate Output 1's solid state switching is on,
DIGITAL SETPOINT
DOOR SWUNG UP TO REVEAL TAMPER-PROOF CONTROLS
HANDLE:—Pull out to remove controller from its housing.
OUTPUT (CONTROL FORM) BOARD
FUSE
2 AMPERES AT 250 Vac
WARNING
FUSE SIZE MUST NOT BE EXCEEDED. COPPER FOIL ON MAIN BOARD WILL BE DESTROYED AT HIGHER CURRENTS.

Figure 1-1. Parts Description

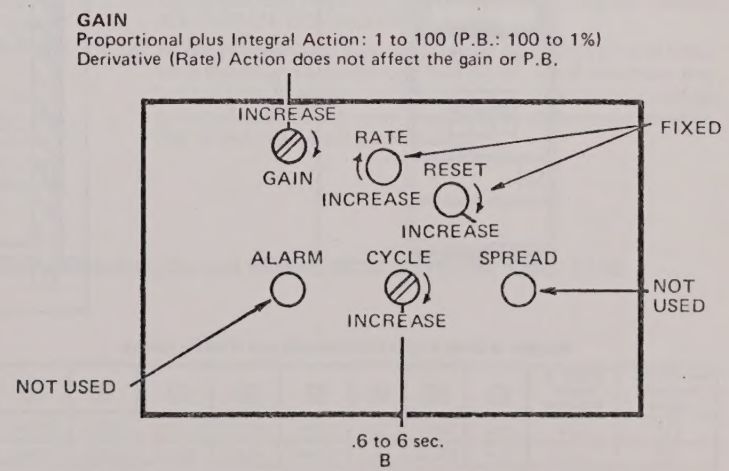


Figure 1-2. Functions of Internal Front Panel Controls

2.1 After Unpacking

Check the contents of the shipping container against the packing slip. If the equipment is damaged in transit, report the extent of the damage to the carrier immediately.

2.2 Mounting

The Series 520 can be mounted in any position. The instrument is rated for an ambient temperature from 5° to 55°C (40° to 130°F).

After the cutout is made in the panel, proceed as follows to install one instrument. Completely unscrew the two driving screws for the mounting brackets and pull the mounting brackets completely out of their tracks in the case. Place the housing in the panel cut-out. Replace the mounting brackets. Tighten the mounting bracket screws until the brackets hold the housing snugly against the panel. CAUTION: Do not over-tighten the mounting bracket screws — over-tightening screws could damage the panel.

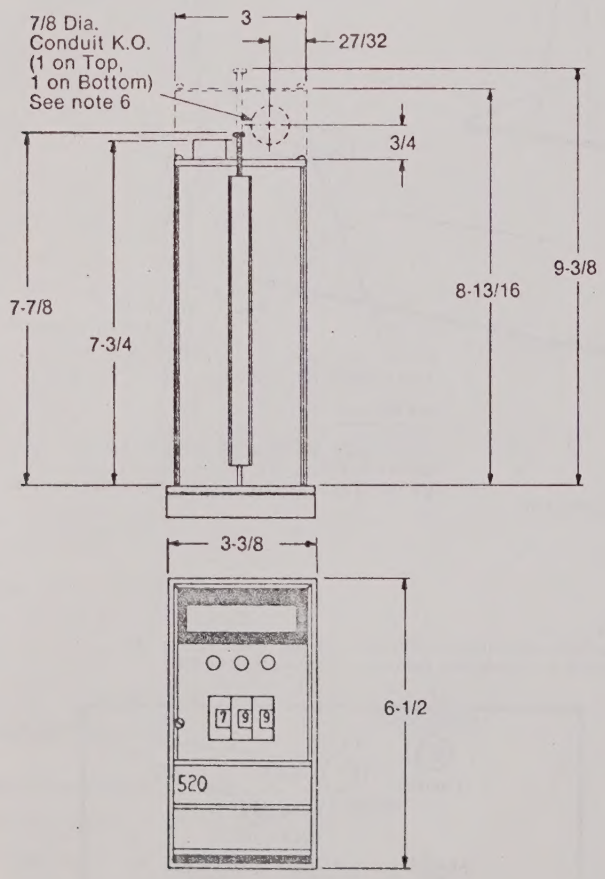
The captive screw on the left side of the panel in the middle is the fastener for the instrument. After the housing is mounted in the panel, push the controller firmly into its slot until the screw touches the threaded hole in back of it. Do not push instrument further but instead turn screw clockwise until instrument is pulled fully into its housing.

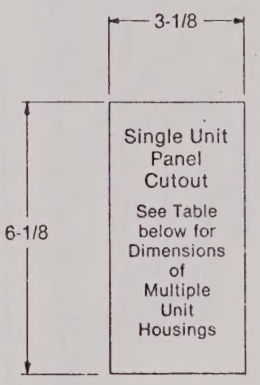
2.3 Power Wiring

Input line voltage must be 120 or 240 Vac, ± 10%, at 60 Hz; or, 110 or 220 Vac, ± 10%, at 50 Hz; by rear terminal selection. Connect the line voltage to the terminal marked L2 and either the terminal marked 240V L1 or the terminal marked 120V L1. Connect panel ground to the GROUND terminal.

2.4 Input Wiring

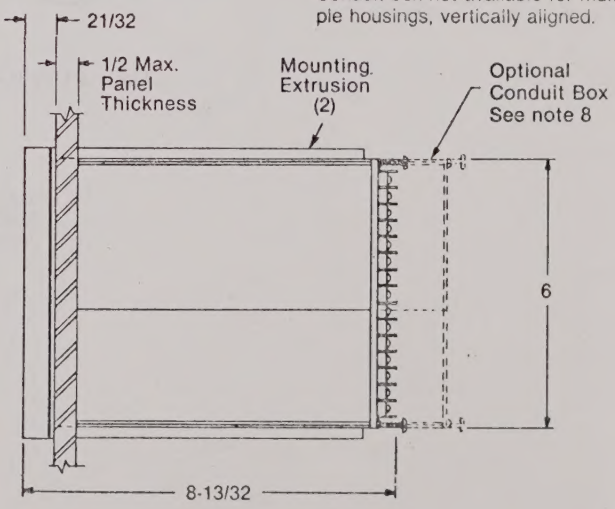
Install a quality Barber-Colman thermocouple for your application. Barber-Colman thermocouple catalogs, such as 1111/DB 12 and 1130/DB 1, list a complete line of thermocouple assemblies and thermocouple extension leadwire.





NOTES:

1. All dimensions in inches.
2. Tolerance all dimensions ± 1/16.
3. Dimensions guaranteed only if this print is certified. Consult factory.
4. Min. horz. spacing centers 3-7/16.
5. Min. vert. spacing centers 6-9/16.
6. Appleton No. 92T050 two piece steel conduit connector or equivalent must be used for conduit connections.
7. For mounting in a 19" relay rack 7" high the max. no. of units will be 1 row of 5.
8. Conduit box fitted to case at factory. Conduit box not available for multiple housings, vertically aligned.



Number of Units Aligned Horizontally and Width in Inches

No. of Units Vertically Aligned	Height of Cutout in Inches	1	2	3	4	5	6	7	8	9
1	6-1/8	3-1/8	6-9/16	10	13-7/16	16-7/8	20-5/16	23-3/4	27-3/16	30-5/8
2	12-11/16	3-1/8	6-9/16	10	13-7/16	16-7/8	20-5/16	23-3/4	27-3/16	30-5/8

All Dimensions in Inches

Total Number of Units = Units Horizontal × Units Vertical

Examples:

1. Single Panelmount cutout is 3-1/8" wide by 6-1/8" high.
2. An array of 9 wide by 2 high, cutout is 30-5/8" wide by 12-11/16" high.
3. For one row of 5 housings, cutout is 16-7/8" wide by 6-1/8" high.

Note: Standard Relay Rack Panel Cutouts are made at the factory; and, the housings specified are shipped fastened to the panel. **See 1252/DB 3 for more information on Multiple Unit Housings.**

Figure 2-1. Mounting Dimensions

The SIGNAL input terminals are marked TC + and TC – and are for any input.

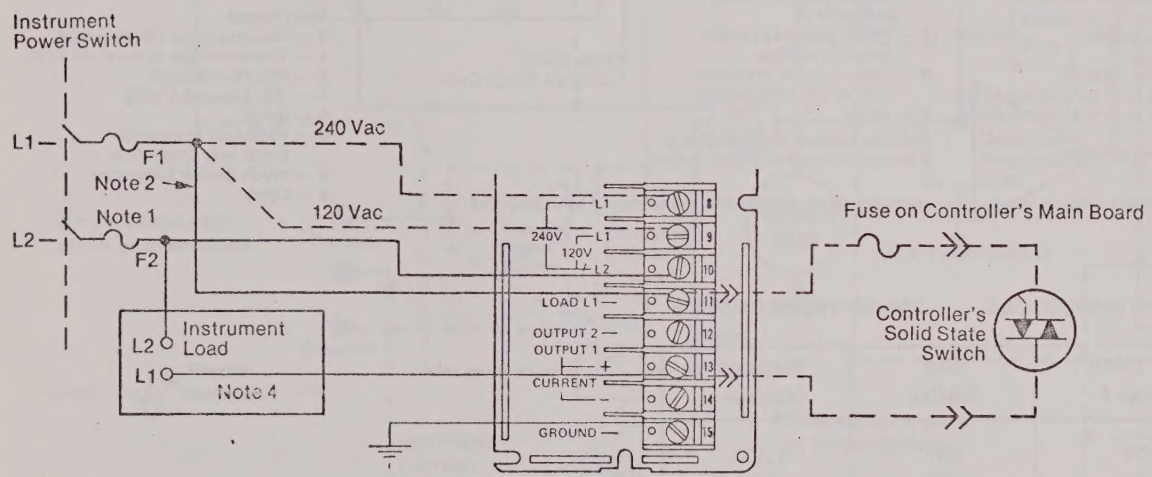
Thermocouples should never be wired using ordinary copper wire. Use only thermocouple extension leadwire.

Observe the correct thermocouple and thermocouple extension wire polarity. The NEGATIVE (–) wire is usually coded RED.

Do not place power wiring and thermocouple wiring in the same conduit or wiring trough.

If shielded thermocouple leads are used, shields should be insulated electrically and terminated at one location, preferably the instrument chassis.

For RTD sensors there is no polarity to observe. For three wire RTD sensors, connect the two WHITE wires together.



Notes:

1. Instrument power switch and instrument fuses are included for illustrative purposes only. If the L2 line is a neutral or ground line, fuse F2 is not normally recommended. Consult local codes and appropriate wiring standards.
2. Instrument load power, LOAD L1, may be obtained from a separate power source in phase with the instrument power supply. Instrument signal light will not operate unless instrument L2 and instrument load L2 are connected as shown. Instrument signal light will not operate if LOAD L1 is powered by a separate source of less than 100 Vac rms.
3. Instrument load may be either a contactor coil, a Barber-Colman SOLID STATE CONTACTOR, or heater.
4. Rating of Solid State Switching Output: (both ON-OFF and Time-Proportioning): 1A continuous, 10A inrush, 50mA minimum. Any voltage from 24 Vac to 240 Vac can be switched but the voltage switched must be the same phase and have the same common line as the instrument power supply.

Figure 2-2. Output Wiring, Single Solid State Switching Output Models 521A and 522B, 523B, 524B

THIS MODEL NUMBER CODE EXPLAINS THE MODEL NUMBER STAMPED ON THE CONTROLLER

WRITE THE ENTIRE 15-DIGIT CODE WHEN ORDERING

52□□ - □ □□□□ - □□□ - □ - □□

Series

Control Mode
1 — ON-OFF or Limitrol (only with A, L or T below)
2 — Proportional Controller
3 — Proportional + Integral (Reset)
4 — Proportional + Integral + Derivative (Rate)

Output Control Form
A — ON-OFF (only with 1 above)
B — Time Proportioning
C — Current: 2-12 mA, Reverse Acting
D — Current: 4-20 mA, Reverse Acting
E — Dual—Time Proportioning and on-off auxiliary output
F — Dual—Current 2-12 mA and on-off auxiliary output
G — Dual—Current 4-20 mA and on-off auxiliary output
H — Dual—Time Proportioning on both outputs
J — Dual—Current 2-12 mA and Time Proportioning auxiliary output
K — Dual—Current 4-20 mA and Time Proportioning auxiliary output
L — Limitrol (only with 1 above)
P — Current: 2-12 mA, Direct Acting
Q — Current: 4-20 mA, Direct Acting
T — Limitrol (only with 1 above)

Setpoint
1 — Analog Setpoint
2 — Analog Setpoint with Remote-Local Switch
3 — Analog Setpoint with output setpoint voltage available
4 — Digital Setpoint (standard)
5 — Digital Setpoint with Remote-Local Switch
6 — Digital Setpoint with output setpoint voltage available
7 — None. Requires remote setpoint voltage
8 — Trim Setpoint. Requires remote setpoint voltage
9 — Other

Setpoint options 2, 3, 5, 6, 7 and 8 include a Process Signal Output

Range Code
Four Digit Range Code

Input Signal
0 — Thermocouple Upscale TCB
1 — Thermocouple Downscale TCB
2 — Resistance Bulb
4 — Vdc (above 0.1 Vdc)
5 — mAdc
6 — Radiation Pyrometer Emissivity Correction
8 — mVdc (below 100 mVdc)
9 — Other

Readouts
1 — Deviation Meter (standard)
3 — Process Meter
5 — Digital Process Meter
7 — Deviation Meter with 1.8 inch Scale

Housing
0 — Panelmount (standard)
1 — Shipped without housing—order housing separately
2 — Panelmount with conduit openings and rear cover

Specify 1 above and see 1252 DB 3 to order high density housings for either Panel or Standard Relay Rack Mounting.

Alarms
0 — None (standard)
1 — Deviation Alarm
2 — Deviation Band Alarm
3 — Process Alarm

Specials
00 — None. Consult factory for all Specials

All of the models include, as standard, indicator lights appropriate to the output form selected.

SP05-0-0751-XXX

TYPE J THERMOCOUPLE 200 TO 799 DEGREES F

True Temp. Degrees F	Dial Setting	Setpoint Voltage
200	201	1.008
225	226	1.171
250	250	1.335
275	275	1.500
300	300	1.666
325	325	1.833
350	350	2.000
375	375	2.168
400	400	1.335
425	425	2.503
450	450	2.671
475	475	2.838
500	500	3.005
525	525	3.172
550	550	3.339
575	575	3.505
600	600	3.671
625	625	3.838
650	650	4.005
675	675	4.171
700	700	4.338
725	725	4.504
750	750	4.671
775	776	4.837
799	798	4.996

Barber-Colman Company
INDUSTRIAL INSTRUMENTS DIVISION
1700 Rock Street, Rockford, Illinois, U.S.A., 61101

MODELS 521, 522, 523 AND 524
MAIN BOARD CIRCUITS, AND CALIBRATION
(Includes Wiring Diagram and Replaceable Mechanical Parts)

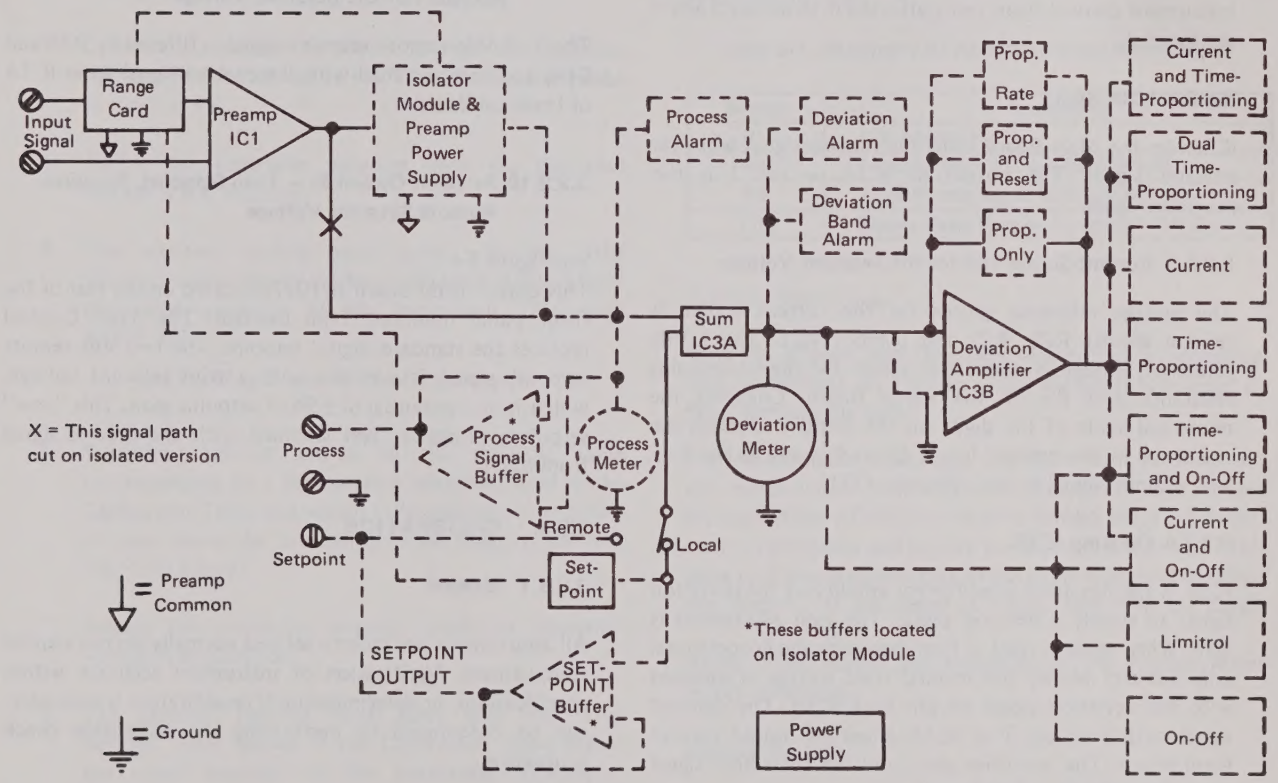


Figure 3-1. Simplified Block Diagram.

3. INTRODUCTION

3.1 General Description

Descriptions common to all models of the Series 520 are included in this section. Figures showing replaceable mechanical parts and a wiring diagram for all models are at the end of the section.

3.2 Main Board

3.2.1 OVERALL DESCRIPTION

See Figure 3-1. For a thermocouple input, the signal to the Preamplifier is the thermocouple signal minus the cold junction reference signal. The Preamplifier amplifies the direct current millivolt input signal to drive an optional process meter and an optional alarm board. When the temperature of the input thermocouple and the temperature set on the front panel setpoint are the same, the output (error signal) of the SUM network on the Main Board is zero. At zero error signal, the input to the deviation meter will be zero, and it will indicate zero deviation. Any signal other than zero is amplified by the Deviation Amplifier. Gain plus Manual Reset or Gain plus Integral plus Derivative action takes place on a separate board. The Demand Signal from the Deviation Amplifier drives the output control board. ON-OFF Control Forms such as the 520L, T, and A and Output 2 of the E, F, and G receive a driving signal directly from the Sum Amplifier output (deviation signal).

3.2.2 CIRCUIT DESCRIPTION

See Schematic Figure 3-3.

3.2.2.1 Preamplifier IC1

The gain is fixed by resistors R6 and R7 on the Range Board. The output of IC1 on pin 10 which ranges from 2 to 10 Vdc is the amplified process signal. This process signal drives the front panel process meter, and also appears on rear panel terminals 3 and 4.

R8 and R9 on the Isolator Board divides the 2 to 10 Vdc down to 1 to 5 Vdc. IC2B is a buffer stage that prevents instrument control from being affected if terminals 3 and 4 are shorted.

3.2.2.2 IC3A Sum

IC3A on the Main Board sums the process signal with the setpoint signal. The output of IC3A on pin 1 is the deviation signal.

3.2.2.3 Current Source IC4 for the Setpoint Voltage

The voltage reference source for the current source is resistor divider R20, R21 and trimpot R22. The 5 Vdc reference voltage is connected across the digital setpoint resistance and R9 on the Range Board. Changing the numerical value of the digits on the setpoint changes the resistance in the emitter leg of Q2 and generates the 1–5 Vdc setpoint signal in the collector of Q2.

3.2.2.4 Op Amp IC3B

IC3B is the deviation amplifier for amplifying the deviation signal to supply a demand signal. The gain adjustment is R23. When manual reset is furnished with the Proportional only Control Mode, the manual reset voltage is summed with the deviation signal on pin 5 of IC3B. The demand signal output on pin 7 of IC3A drives the output control form board. The amplifier also sums the correction signal from either the PI or PID boards.

3.2.2.5 Power Supplies +15 Vdc, -15 Vdc & -30 Vdc

The -30 Vdc supply has only its transformer on the Main Board. The remainder of its circuit is on any output control form board with a current output. The ac voltage from the transformer is on pins 10 and 11 of P5. The +15 Vdc potential is established by IC2 which is an integrated circuit regulator. The +15 Vdc voltage is adjusted by R18. Zener diode D5 and series pass transistor Q1 provides the regulation for the -15 Vdc supply.

3.2.2.6 Setpoint Options 1 and 4: — Setpoint Only

This is the internal setpoint only. Option 4 is standard.

3.2.2.7 Setpoint Options 2 and 5: — Setpoint With Remote Local Switch

This simple circuit switches between remote and internal terminals. The 1–5 Vdc remote setpoint signal is filtered by R30 and C14 and then summed with the process signal from IC1A on the Isolation Board.

3.2.2.8 Setpoint Options 3 and 6: — Setpoint With Output Setpoint Voltage Available

IC3 on Isolation Board is a buffer with a low output impedance. IC3 prevents loss of control action should rear panel terminals 4 and 5 be shorted.

3.2.2.9 Setpoint Option 7: — No Built-in Setpoint, Accepts Remote Setpoint Voltage

The 1–5 Vdc remote setpoint signal is filtered by R30 and C14, and then summed with the process signal from IC1A of Isolation Board.

3.2.2.10 Setpoint Option 8: — Trim Setpoint. Requires Remote Setpoint Voltage

See Figure 3-4.
This option is on board A-10278 located on the rear of the front panel mounted Trim Control. The Trim Control replaces the standard digital setpoint. The 1–5 Vdc remote setpoint signal is summed with a trim setpoint voltage, which is at a potential of ±5% of setpoint span. This "new" setpoint voltage is then summed with the process signal from IC1A.

3.2.3 CALIBRATION

3.2.3.1 General

All adjustments are factory set and normally do not require readjustment. Verification of instrument accuracy within specifications, or determination if recalibration is necessary, can be determined by performing the calibration check procedures.

3.2.3.2 Calibration Equipment

The following equipment is required to calibrate this controller:

1. Differential Voltmeter with 10 mV full scale or less such as Fluke Model 871AB or a Portable Potentiometer such as the Barber-Colman Model PA11-1. Hewlett-Packard Model 427A.

2. Dc millivolt source with outputs of 0–1 mVdc and 0–100 mVdc. Source resistance must be 50 ohms or less.

3. Extender assembly 24-2 for Calibration or Troubleshooting.

Proceed through the following paragraphs in order. Do not skip a paragraph.

3.2.3.3 Calibration Check

THE EXAMPLES IN THIS CALIBRATION CHECK IN PARENTHESES ARE FOR RANGE CODE 0030 (0 to 2000° F, TYPE K).

1. Connect a millivolt source to the sensor input terminals. If the sensor is a thermocouple, be certain the correct thermocouple extension wire is used.

2. Set the millivolt source to the value shown in the Calibration Table for mid-scale temperature. (Example: 1000°F=22.25mV).

3. Connect a precision voltmeter to read the deviation voltage. Positive probe to pin 1 of P5, negative probe to pin 7 of P5.

4. Adjust the controller setpoint until the deviation voltage is 0 ± .025Vdc.

5. The setpoint reading must agree with the "Dial Setting" value shown in the Calibration Table within the rated accuracy of the instrument. (Example: 1001±20).

   ±1% of span plus 0.5% of suppression.

6. Set the millivolt source to the millivolt value corresponding to a temperature which is listed in the Calibration Table and which falls between 10 and 20% of span above the low point of the range. (Example: 200°F=3.82mV).

7. Adjust the controller setpoint until the deviation voltage is 0±.025Vdc.

8. The setpoint reading must agree with the "Dial Setting" value shown in the Calibration Table within the rated accuracy of the instrument. (Example: 208±20).

9. Set the millivolt source to the millivolt value corresponding to a temperature which is listed in the Calibration Table and which falls between 80 and 90% of span above the low point of the range. (Example: 1800°F=40.58mV).

10. Adjust the controller setpoint until the deviation voltage is 0±.025Vdc.

11. The setpoint reading must agree with the "Dial Setting" value shown in the Calibration Table within the rated accuracy of the instrument. (Example: 1790±20).

    ±1% of span plus 0.5% of suppression.

12. If the controller meets the accuracy specifications in steps 5, 8, and 11, the controller is properly calibrated. Do not make any internal adjustments or proceed further in the calibration procedure.

13. If the controller fails to meet the accuracy specifications in either step 5, 8, or 11, the controller must be calibrated.

Table 3-1 lists the adjustments on the Main Board. Always perform the adjustments on the Main Board first. When a Range Board is replaced, readjust R8 and R22 on the Main Board. After replacing either a Process Meter, or a Deviation Meter, readjust R10 on the Main Board.

If any repairs are made, all the adjustments on the Main Board, Control Mode Board (if any) and Output Board (if any) must be made.

Table 3-1. Summary of Adjustments on Main Board

Symbol	Description
R18	+15 Vdc Supply
R22	3 Vdc Setpoint Voltage (MID SPAN)
R8	6 Vdc Process Signal (MID SPAN)
R10	Process Meter Span or Deviation Meter Span

3.2.3.4 Meter Zero

Both the Process and Deviation Meters have a mechanical zero adjustment on the top of the meter. It is covered by tape. Remove the tape.

For the Deviation Meter with the instrument vertical, zero the meter with a non-magnetic screwdriver, and replace the tape. After a Deviation Meter is zeroed, place the instrument in the panel and be sure the meter is still at zero. This detects if any magnetic flux in the panel is present to offset the meter — if the meter is offset, zero it in the panel.

Apply 1Vdc across the terminals of the Process Meter before zeroing it.

Replace the tape.

3.2.3.5 ±15 Vdc Supply

A voltmeter capable of reading voltages to five significant figures in the range of 0–16 Vdc is required. Assuming such a voltmeter is available, proceed as follows:

1. Turn power on to the Series 520.

2. Set the voltmeter to read up to 16.000 Vdc.

3. Connect the probes of the voltmeter across the 15 Vdc supply (positive probe to pin 11 of P2, negative probe to pin 10). To locate these pins look at P2 on the Range Board. There are 11 pins on P2, and they are numbered 1 through 11, from left to right.

4. Adjust R18 until 15.000 Vdc±.015 Vdc is obtained.

5. Remove the probes.

6. Seal R18.

7. The -15 Vdc supply can be measured between pins 5 and 7 of P5 Output Board. Connect the positive probe to pin 7 and the negative probe to pin 5. The voltage read should not be less than 13.650 Vdc or more than 15.150 Vdc. To locate these pins first look at the board parts location drawing in the Output section of this manual.

8. Allow power to remain on to the instrument.

3.2.3.6 Setpoint

3.2.3.6.1 Digital

1. Turn the front panel SETPOINT ADJUST control to mid span of the setpoint range. (Example: 1000°F).

2. Set the voltmeter to read up to 4.000 Vdc.

3. Connect the positive probe of the voltmeter to pin 1 of P2 and the negative probe of the voltmeter to pin 10 of P2.

4. Adjust R22 until 3.000 Vdc±.003 Vdc is obtained.

5. Seal R22.

6. Allow power to remain on to the instrument.

3.2.3.6.2 Analog

1. Connect the positive probe of the voltmeter to the blue wire on the Analog Setpoint Board A-10503. Connect the negative probe to pin 10 of P2 on the Range Board.

2. Remove the setpoint knob.

3. Turn the SETPOINT ADJUST Control fully CCW. Observe the reading on the voltmeter. Slowly turn the SETPOINT ADJUST Control CW until a 25 mVdc change is observed on the voltmeter.

4. Reinstall the setpoint knob. Carefully align the pointer to the lowest scale value.

5. Adjust R5 on the Setpoint Board A-10503 for 1.000 Vdc±1 mVdc.

6. Turn the SETPOINT ADJUST Control fullscale.

7. Adjust R2 on the Setpoint Board for 5.000 Vdc±5 mVdc.

8. Repeat steps 5 through 7.

3.2.3.7 Deviation Signal Null

1. Adjust the front panel SETPOINT ADJUST control to the setting on the Calibration Table that corresponds to the midspan of the instrument. (Not necessarily the same as midspan of setpoint) (Example: 1001 setting = 1000°F).

2. Connect the dc millivolt source to input terminals 1 and 2. Be certain the polarity of the connections is correct.

3. Adjust the D.C. millivolt source for the equivalent millivolts of the same midscale temperature used in step 1. (Example: 1000°F=22.25mV).

4. Measure the deviation output of IC3A as follows: Connect the positive probe to pin 1 of P5, and the negative probe to pin 7 of P5. The precision voltmeter should read 0 Vdc ±.025 Vdc. Adjust R8 for zero deviation.

5. Seal R8, if Isolation Board is not present.

6. Allow power to remain on to the instrument.

7. If Isolation Board is installed, proceed to Isolation Board Adjustments and lastly do the Meter Span Adjustment.

3.2.3.8 Meter Span

If the controller has a Deviation Meter set the input source for the equivalent of midscale temperature and adjust the setpoint for the maximum deviation that corresponds to the deviation meter scale. For example, assume the controller has a 0 to 400°F range and a Deviation Meter with a scale marked -30 to 0 to +30. Adjust the setpoint to 230°F. Deviation Meter should read -30° to within one major division. Adjust R10 if it does not. Next, adjust the setpoint to 170°F. Deviation Meter should read +30°F to within one major division. Adjust R10 if it does not.

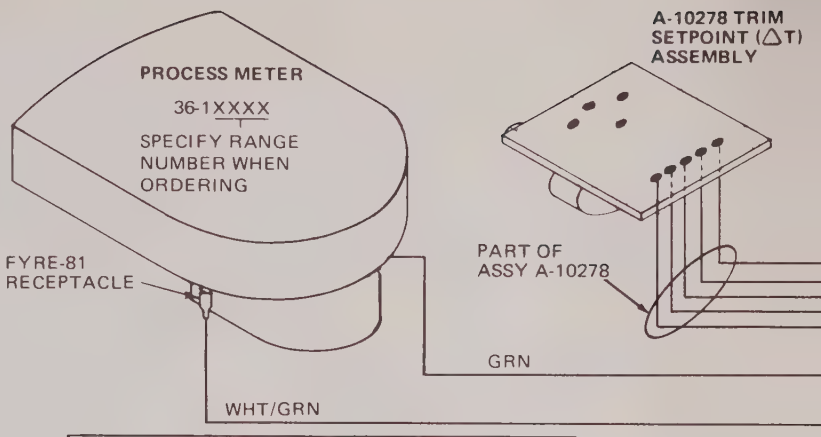
If the controller has a process meter, it should be indicating mid span when the dc millivolt source is set for the equivalent of midscale temperature. If it does not, adjust R10 until it does.

Allow power to remain on to the instrument and next perform any adjustments (if any) for the Control Mode and Output Sections, respectively, of this manual.

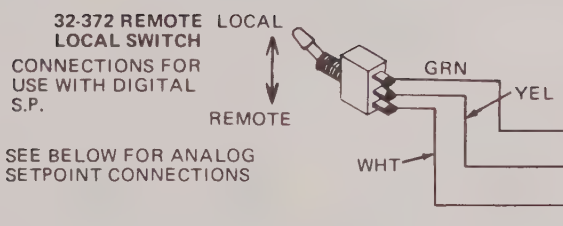
Table 3-2. Complete Main Board Assemblies

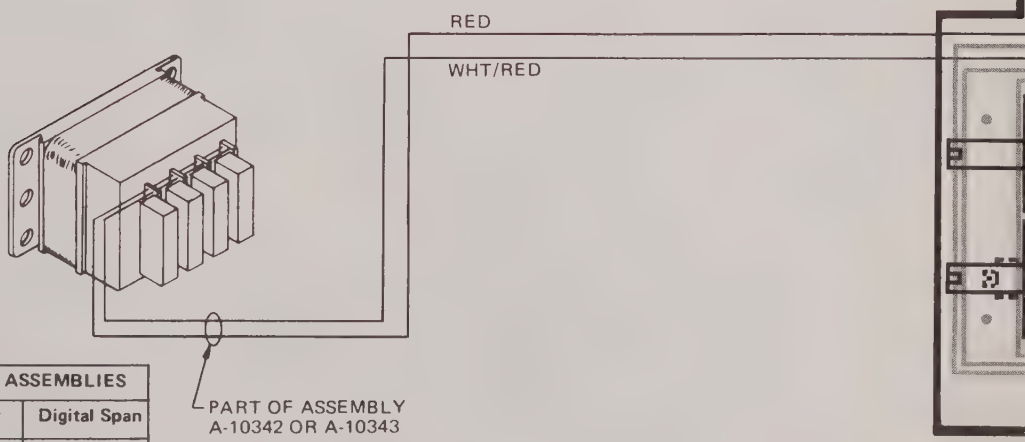
Assembly Number	Setpoint Option	Description of Feature Making Board Different from Other Main Boards
A-11410-100	4	Digital Setpoint
A-11410-200	5	Digital Setpoint with Remote–Local Switch
A-11410-300	6	Digital Setpoint with output setpoint voltage
A-11410-400	7	No setpoint. Requires remote setpoint voltage.
A-11410-500	8	Trim Setpoint. Requires remote setpoint voltage.
A-11410-600	1	Analog Setpoint
A-11410-700	2	Analog Setpoint with Remote–Local Switch
A-11410-800	3	Analog Setpoint with output setpoint voltage

Deviation Meter Part Numbers		
Part Number	Scale	Span (Units)
36-093-100	50-0-50	401-800
36-093-200	30-0-30	400 or less
36-093-300	100-0-100	801-1600
36-093-400	200-0-200	1601-3000
36-093	10-0-10	% Deviation



PROCESS METER PART NUMBERS
PROCESS METER ASSEMBLY 36-1 XXXX
RANGE CODE OF INSTRUMENT





SETPOINT SWITCH ASSEMBLIES		
Digits	Part Number	Digital Span
3	A-10342-100	0–X99
3	A-10342-200	200-X1199
3	A-10342-300	500-X1499
4	A-10343	0-X999
3	A-10342-400	1300-2399

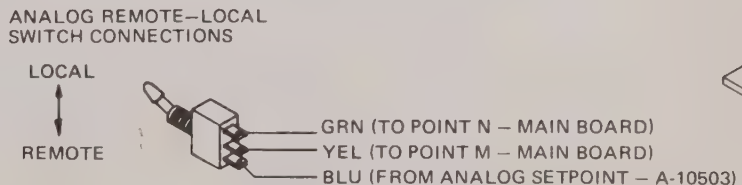
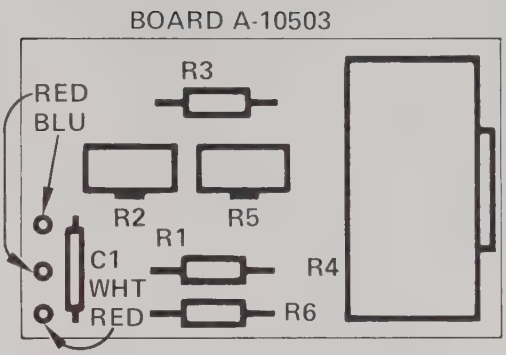

ANALOG REMOTE–LOCAL SWITCH CONNECTIONS
LOCAL
REMOTE
GRN (TO POINT N – MAIN BOARD)
YEL (TO POINT M – MAIN BOARD)
BLU (FROM ANALOG SETPOINT – A-10503)

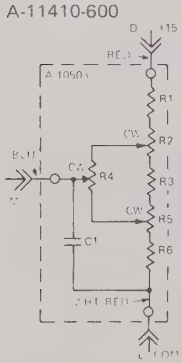
Table 3-3. Analog Setpoint Board A-10503 (Mounted on Analog Setpoint Pot)

Symbol	Part Number	Description
	CAPACITOR	
C1	39-325	.05μF, 20%, 100 WVDC
	RESISTORS	
R1	CYZR-864-256	3740 ohms, .5%, 1/8W
R2	29-399	Variable, 200 ohms, 20%, 1/2W
R3	CYZR-864-218	1500 ohms, .5%, 1/8W
R4	29-395	Variable, 20k ohms, 10%, 2W
R5	29-398	Variable, 100 ohms, 20%, 1/2W
R6	CYZR-861-151	332 ohms, 1%, 1/8W

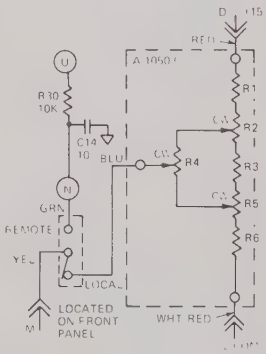


ANALOG OPTIONS

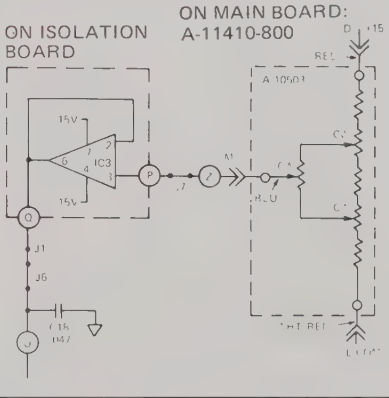
OPTION 1
ANALOG SETPOINT
ON MAIN BOARD: A-11410-600



OPTION 2
ANALOG SETPOINT WITH REMOTE-LOCAL SWITCH
ON MAIN BOARD: A-11410-700

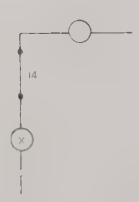


OPTION 3
ANALOG SETPOINT WITH OUTPUT SETPOINT VOLTAGE AVAILABLE
ON ISOLATION BOARD
ON MAIN BOARD: A-11410-800

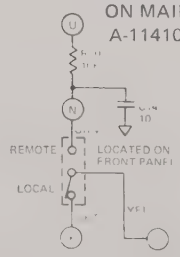


SETPOINT OPTIONS

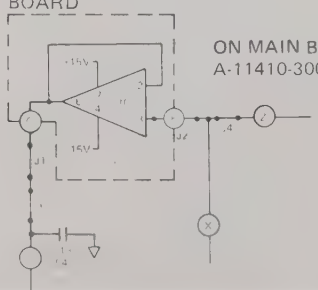
OPTION 4
DIGITAL SETPOINT
ON MAIN BOARD: A-11410-100



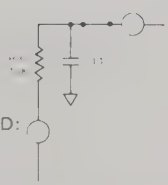
OPTION 5
DIGITAL SETPOINT WITH REMOTE–LOCAL SWITCH
ON MAIN BOARD: A-11410-200



OPTION 6 REMOTE SETPOINT
DIGITAL SETPOINT WITH OUTPUT SETPOINT VOLTAGE AVAILABLE
ON ISOLATION BOARD
ON MAIN BOARD: A-11410-300



OPTION 7
REMOTE SETPOINT
ON MAIN BOARD:



OPTION 8
WITH TRIM (△T)

FOR MAIN BOARD: A-11410-500

(See Fig. 3-4)

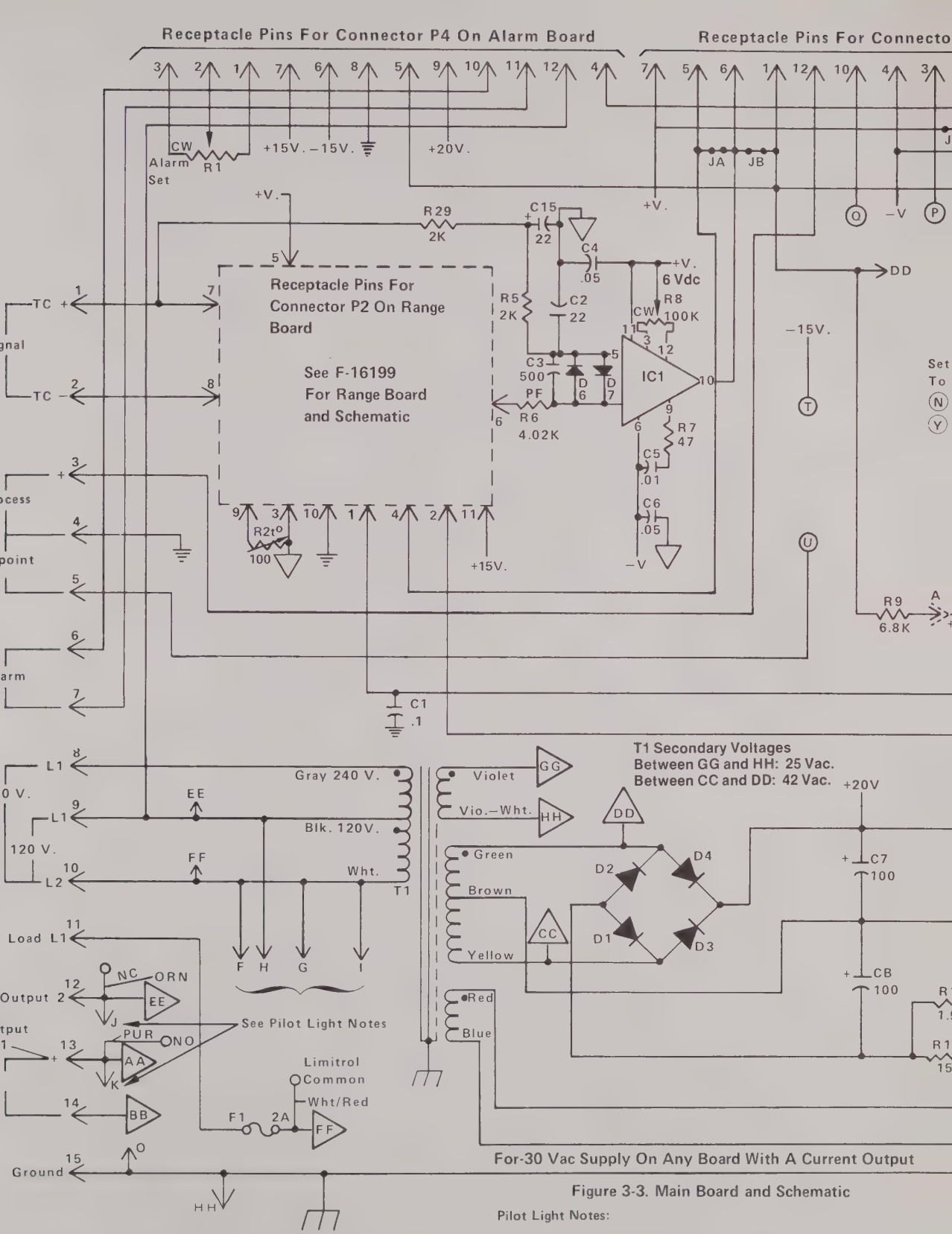
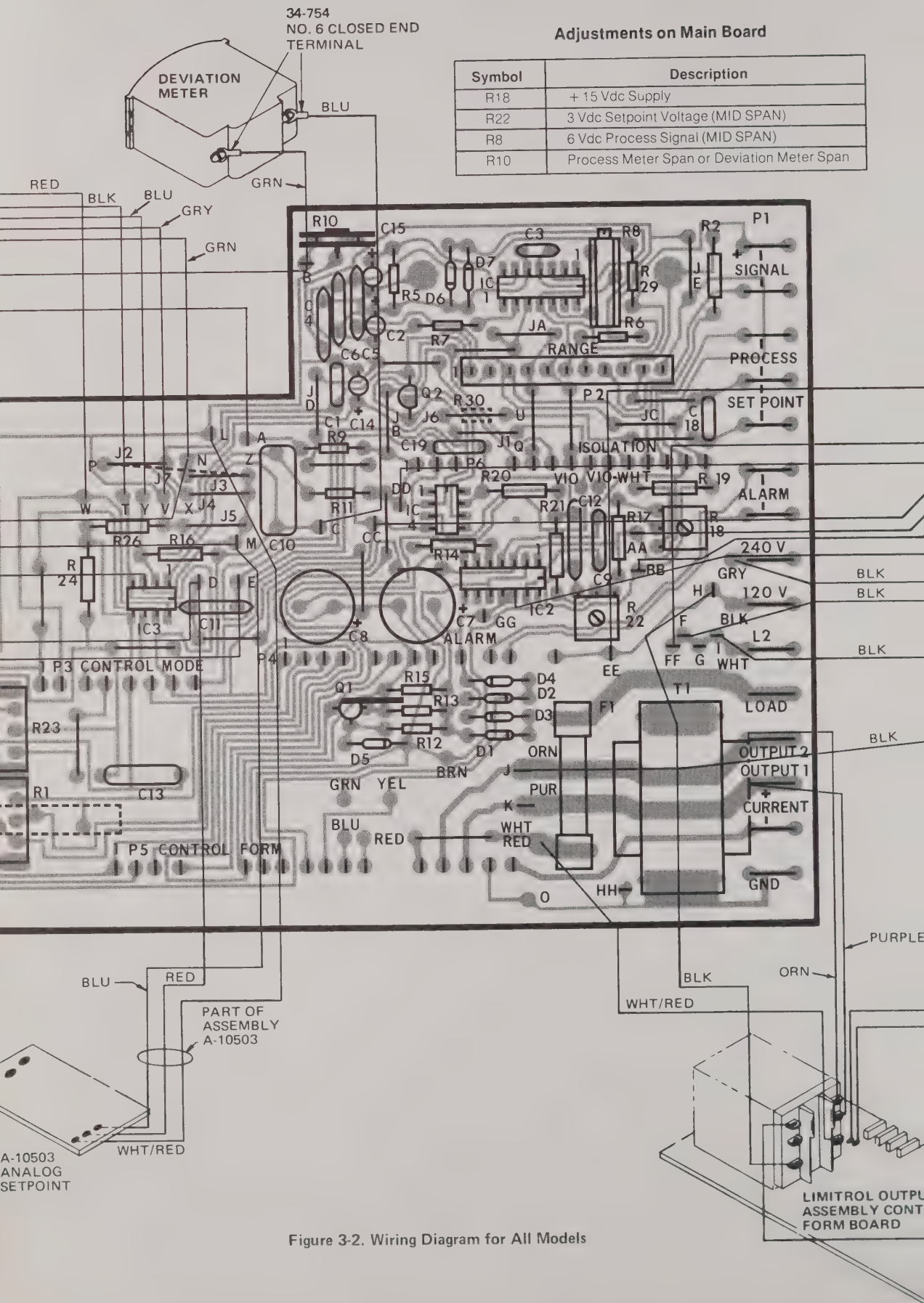


Figure 3-3. Main Board and Schematic

Pilot Light Notes:

1. For single time prop. or single on-off outputs, amber light is connected between pins G & K.

2. For dual time prop. or time prop. + on-off outputs, white light is connected between pins F & J and amber light is connected between pins G & K.

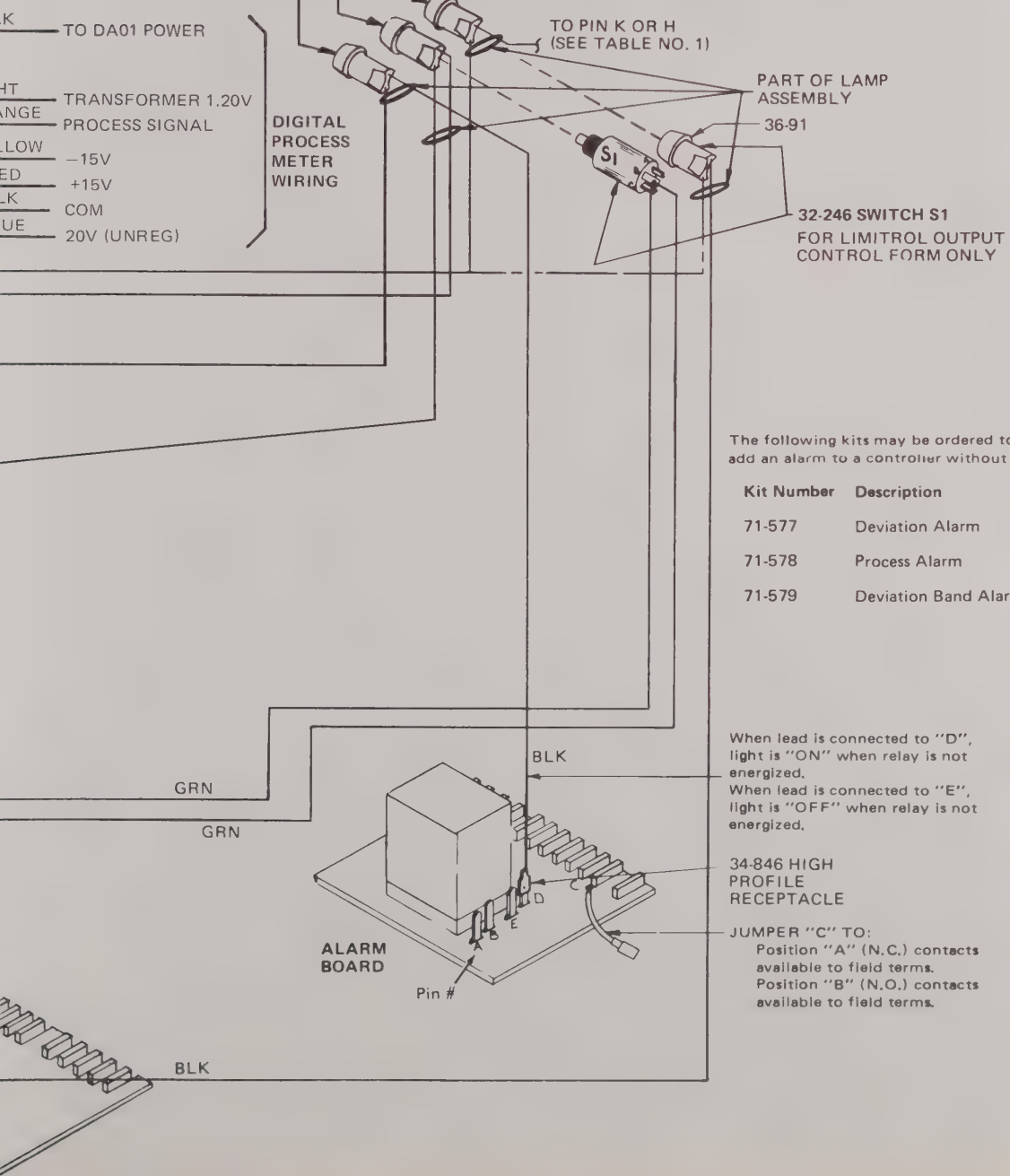


Adjustments on Main Board

Symbol	Description
R18	+ 15 Vdc Supply
R22	3 Vdc Setpoint Voltage (MID SPAN)
R8	6 Vdc Process Signal (MID SPAN)
R10	Process Meter Span or Deviation Meter Span

Figure 3-2. Wiring Diagram for All Models

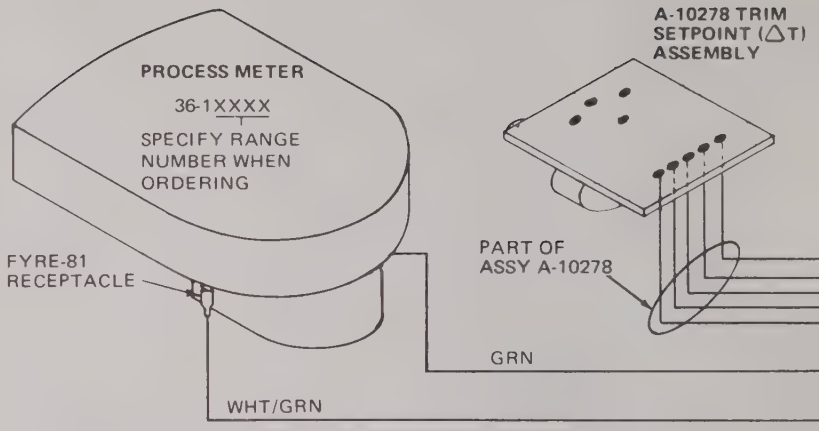
Control Farm	Lamp and Connector	Pin Connection		Lamp and Connector	Pin Connection		Lamp and Connector	Pin Connection	
A, B	36-91-101 Red	I	Alarm Board D or E	None Required			36-111-100 Amber	G	K
C, D, P, Q								G	H
E, H								G	K
F, G, J, K				36-110-100 White	F	J		G	H
L or T				Switch (S1)	Part of Limitrol Bd.		36-112-100 Red	G	N.C. Contact of Relay



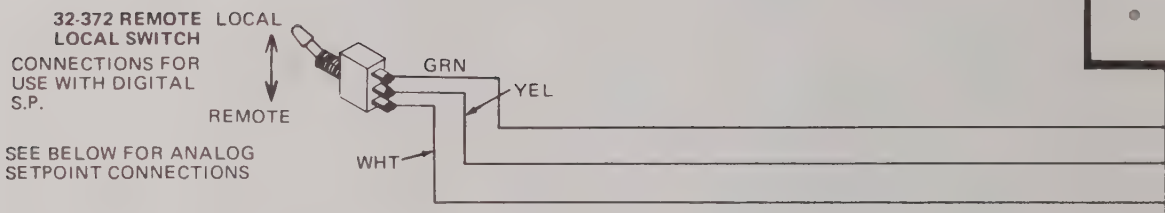
The following kits may be ordered to add an alarm to a controller without one.

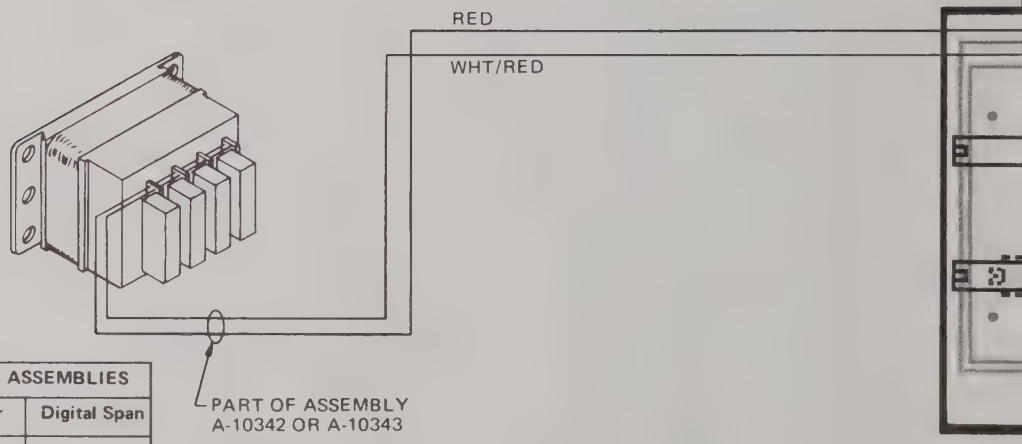
Kit Number	Description
71-577	Deviation Alarm
71-578	Process Alarm
71-579	Deviation Band Alarm

Deviation Meter Part Numbers		
Part Number	Scale	Span (Units)
36-093-100	50-0-50	401-800
36-093-200	30-0-30	400 or less
36-093-300	100-0-100	801-1600
36-093-400	200-0-200	1601-3000
36-093	10-0-10	% Deviation

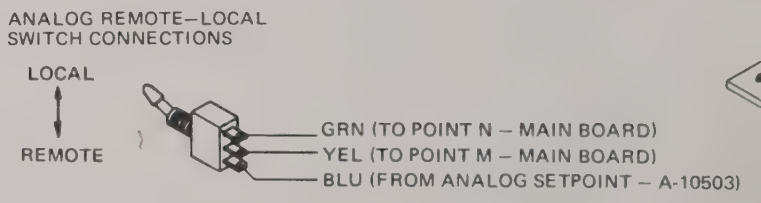


PROCESS METER PART NUMBERS
PROCESS METER ASSEMBLY 36-1 XXXX
RANGE CODE OF INSTRUMENT





SETPOINT SWITCH ASSEMBLIES		
Digits	Part Number	Digital Span
3	A-10342-100	0–X99
3	A-10342-200	200-X1199
3	A-10342-300	500-X1499
4	A-10343	0-X999
3	A-10342-400	1300-2399


ANALOG REMOTE–LOCAL SWITCH CONNECTIONS
LOCAL
REMOTE
GRN (TO POINT N – MAIN BOARD)
YEL (TO POINT M – MAIN BOARD)
BLU (FROM ANALOG SETPOINT – A-10503)

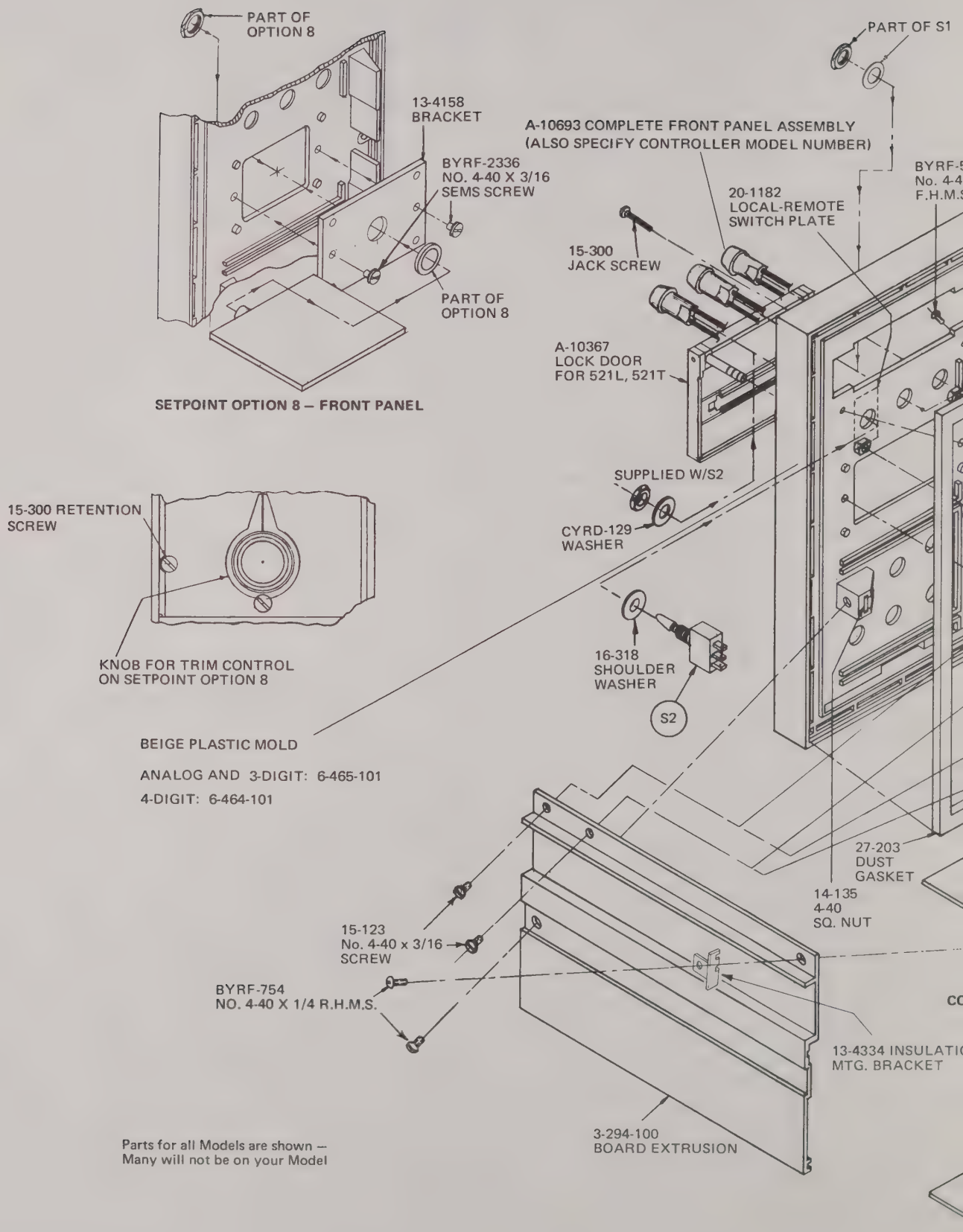

PART OF OPTION 8
13-4158 BRACKET
BYRF-2336 NO. 4-40 X 3/16 SEMS SCREW
PART OF OPTION 8
SETPOINT OPTION 8 – FRONT PANEL
PART OF S1
A-10693 COMPLETE FRONT PANEL ASSEMBLY (ALSO SPECIFY CONTROLLER MODEL NUMBER)
20-1182 LOCAL-REMOTE SWITCH PLATE
15-300 JACK SCREW
A-10367 LOCK DOOR FOR 521L, 521T
SUPPLIED W/S2
CYRD-129 WASHER
15-300 RETENTION SCREW
KNOB FOR TRIM CONTROL ON SETPOINT OPTION 8
16-318 SHOULDER WASHER
S2
BEIGE PLASTIC MOLD
ANALOG AND 3-DIGIT: 6-465-101
4-DIGIT: 6-464-101
27-203 DUST GASKET
14-135 4-40 SQ. NUT
15-123 No. 4-40 x 3/16 SCREW
BYRF-754 NO. 4-40 X 1/4 R.H.M.S.
13-4334 INSULATI MTG. BRACKET
3-294-100 BOARD EXTRUSION
Parts for all Models are shown – Many will not be on your Model

Figure 3-5. Replaceable Mechanical Parts Fo

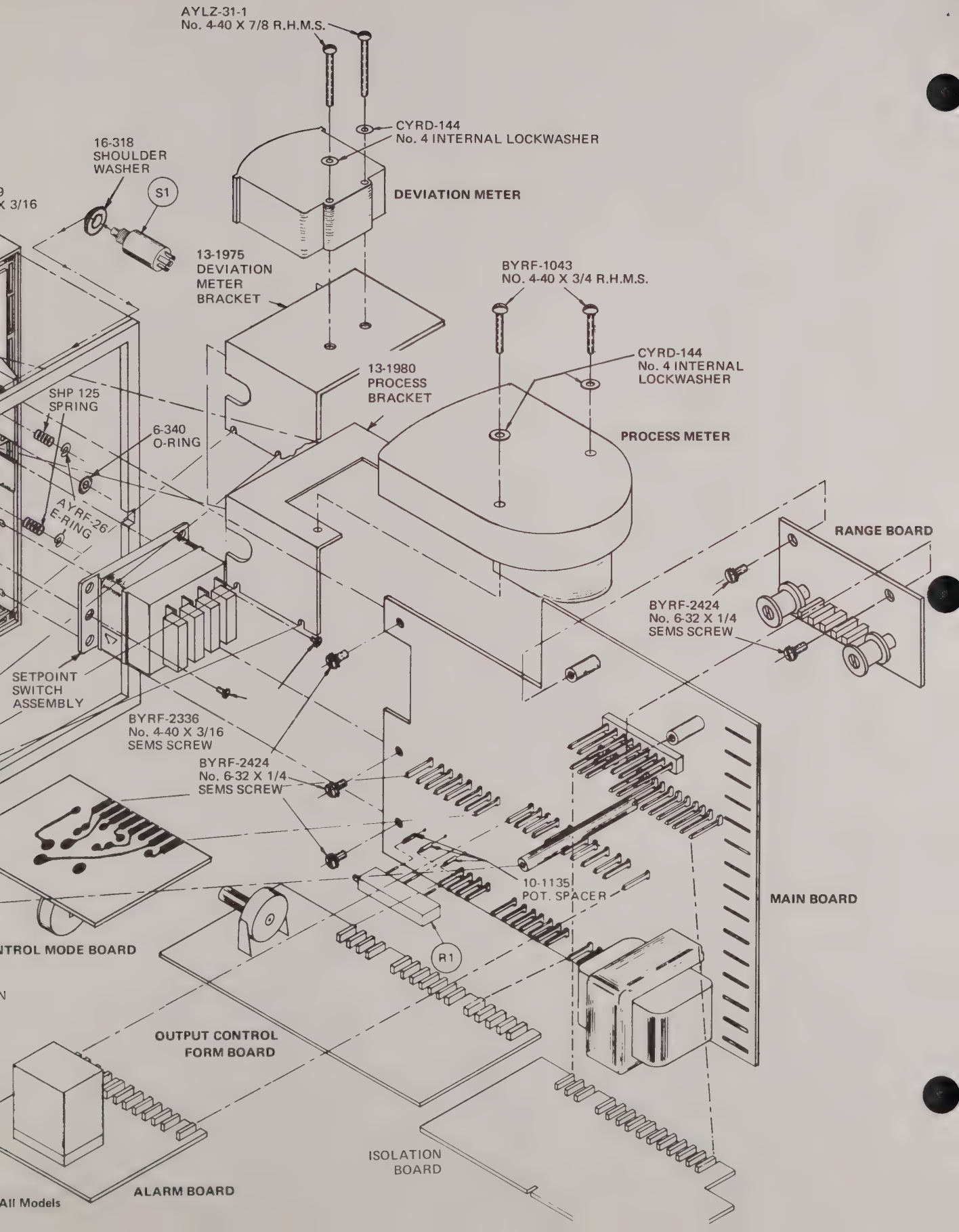
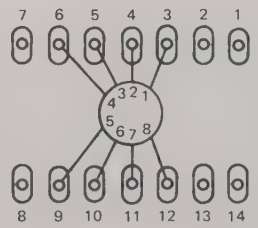

AYLZ-31-1
No. 4-40 X 7/8 R.H.M.S.
CYRD-144
No. 4 INTERNAL LOCKWASHER
16-318
SHOULDER
WASHER
S1
DEVIATION METER
13-1975
DEVIATION
METER
BRACKET
BYRF-1043
NO. 4-40 X 3/4 R.H.M.S.
CYRD-144
No. 4 INTERNAL
LOCKWASHER
13-1980
PROCESS
BRACKET
PROCESS METER
SHP 125
SPRING
6-340
O-RING
AYRF-26
E-RING
RANGE BOARD
BYRF-2424
No. 6-32 X 1/4
SEMS SCREW
SETPOINT
SWITCH
ASSEMBLY
BYRF-2336
No. 4-40 X 3/16
SEMS SCREW
BYRF-2424
No. 6-32 X 1/4
SEMS SCREW
10-1135
POT. SPACER
MAIN BOARD
R1
OUTPUT CONTROL
FORM BOARD
ISOLATION
BOARD
ALARM BOARD
All Models

Table 3-3. Main Boards, Parts List

Symbol	Part Number	Description
	CAPACITORS	
C1	CYZR-803	.1μF 20%, 250WVDC
C2,15	39-414	22μF 10%, 15 WVDC
C3	39-387	500ρF 20%, 100 WVDC
C4,6	39-325	.05μF 20%, 100 WVDC
C5	39-103	.01μF 6 GMV, 100 WVDC
C7,8	39-163	100μF +100 -10%, 50 WVDC, Electrolytic
C9	39-069	100μF 5%, 600 WVDC
C10	CYZR-824	1ρF 20%, 100 WVDC
C11,12,19	39-449	.047μF 10%, 250 WVDC
C13	39-433	.22μF 10%, 250 WVDC
C14	39-400	10μF 20%, 15 WVDC (Only on A-11410-200, 400, & -700)
C18	39-449	.047μF 10%, 250 WVDC (Only on A-11410-300, -800)
	DIODES	
D1,2,3, 4,6,7	EYZP-384	Silicon, 250 PIV, 100 mA (Transition SG3087)
D5	37-204	Zener, 15V 5%, 400 mW
	FUSE	
F1	50-1223	20 Ampere, Type AGC 20 (Model 521L and 521T)
	SYZE-206	2 Ampere, Type AGC-2 (All other models)
	INTEGRATED CIRCUITS	
IC1	31-1011 or 31-1014	725C Operational Amplifier
IC2	31-1010	723C Voltage Regulator
IC3	31-1015 Dual	741C Minidip Operational Amplifier
IC4	31-1012	741C Minidip Operational Amplifier (omit on A-11410-600, -700, & -800)
	WIRE JUMPERS	
J1	Only on A-11410-300 & -800	
J2	Only on A-11410-300	
J3	Only on A-11410-400	
J4	Only on A-11410-100 & -300	
J5	Only on A-11410-500	

Symbol	Part Number	Description
	WIRE JUMPERS (Cont)	
J6	Only on A-11410-300, -500 and -800	
J7	Only on A-11410-800	
	TRANSISTOR	
Q1	31-162	HS5819
Q2	EYZP-623	2N4126 (omit on A-11410-600, -700, & -800)
	RESISTORS	
Resistors are 10% tolerance, 1/4W, unless otherwise stated.		
R1	29-380	Process ALARM Potentiometer: 50k ohms, 3/4W
R1	29-374	Deviation ALARM Potentiometer: 5k ohms 20%
R2	MYDA-29-60	100 ohms 1%
R5,29	CYZR-861-230	2k ohms 1%, 1/8W
R6	CYZR-861-259	4.02k ohms 1%, 1/8W
R7	40-1751	47 ohms
R8	29-220	Variable, 100k ohms, 3/4W
R9	40-1922	6.8k ohms
R10	BYZR-162-5	Variable, 3k ohms 30%
R11	CYZR-861-330	20k ohms 1%, 1/8W
R12	CYZR-481-150	1.5k ohms
R13	CYZR-466	150 ohms
R14	CYZR-862-218	2.5k ohms 1%
R15	CYZR-481-350	4.7 ohms
R16	CYZR-862-330	20k ohms 1%
R17	CYZR-864-251	33.2k ohms .5%, 1/8W
R18	29-383	Variable, 1k ohm 20%, 1/2W
R19	CYZR-864-247	3.01k ohms .5%, 1/8W
R20	CYZR-864-268	4.99k ohms .5%, 1/8W
R21	CYZR-864-295	9.53k ohms .5%, 1/8W
R22	29-383	Variable, 1k ohm 20%, 1/2W
R23	29-370	GAIN Potentiometer, 25k ohms 30%
R24,26	CYZR-862-268	4.99k ohms 1%
R30	CYZR-861-301	10K ohms 1%, 1/8 W (Only on A-11410-200, -400, & -700)
	TRANSFORMER	
T1	30-346-2	Power



View for Installing 31-1011 (Round Can IC) In Place Of 31-1014 (D.I.P.)

For Continuation of Circuit See Figure 3-3.

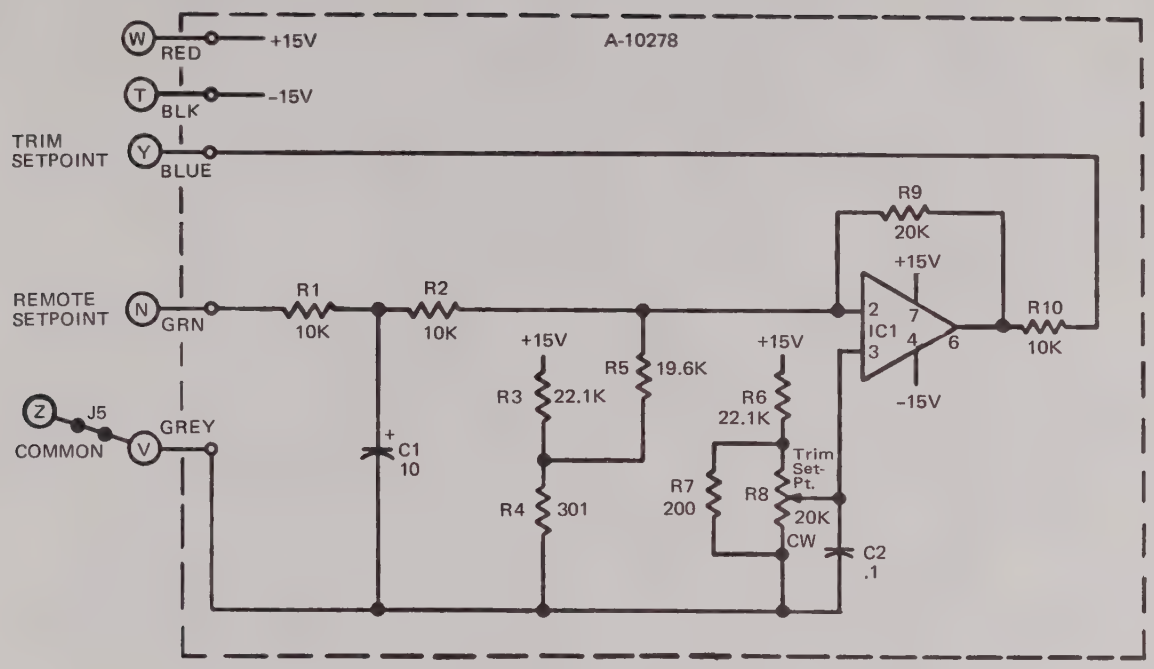
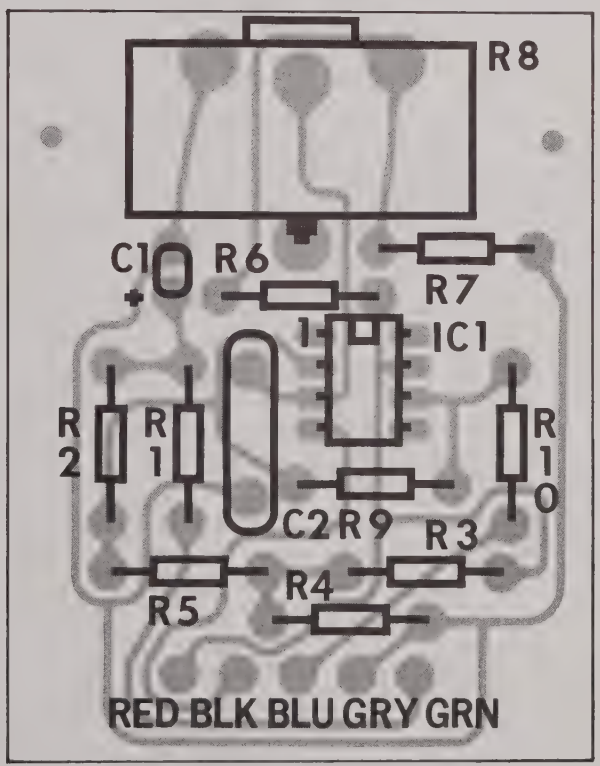


Table 3-4. Trim Setpoint Board A-10278 Parts List

Symbol	Part Number	Description
	CAPACITORS	
C1	39-400	10μF, 20%, 15 WVDC
C2	CYZR-803	.1μF, 10%, 250 WVDC
	INTEGRATED CIRCUIT	
IC1	31-1012	741C
	RESISTORS	
Resistors are 1%, 1/8W, unless stated otherwise.		
R1,2, 10	CYZR-861-301	10k ohms
R3,6	CYZR-861-334	22.1k ohms
R4	CYZR-861-147	301 ohms
R5	CYZR-861-329	19.6k ohms
R7	CYZR-861-130	200 ohms
R8	29-386	Variable, 20k ohms, 10%, 2W, W.W., TRIM Control
R9	CYZR-861-330	20k ohms



This board is located on the rear of the front panel mounted trim control.

Figure 3-4. Trim Setpoint Board and Schematic

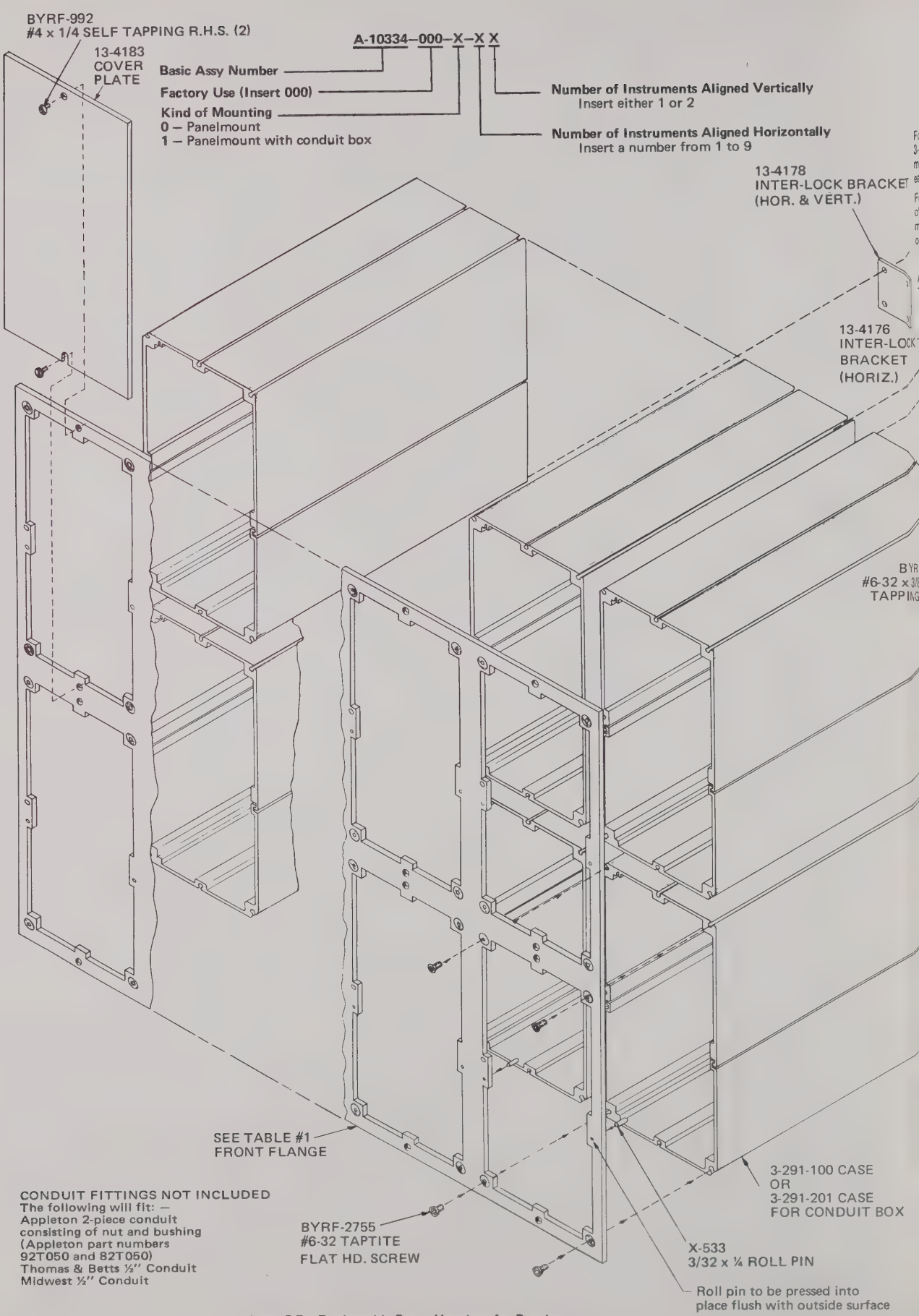


Figure 3-7. Replaceable Parts, Housings for Panelmount

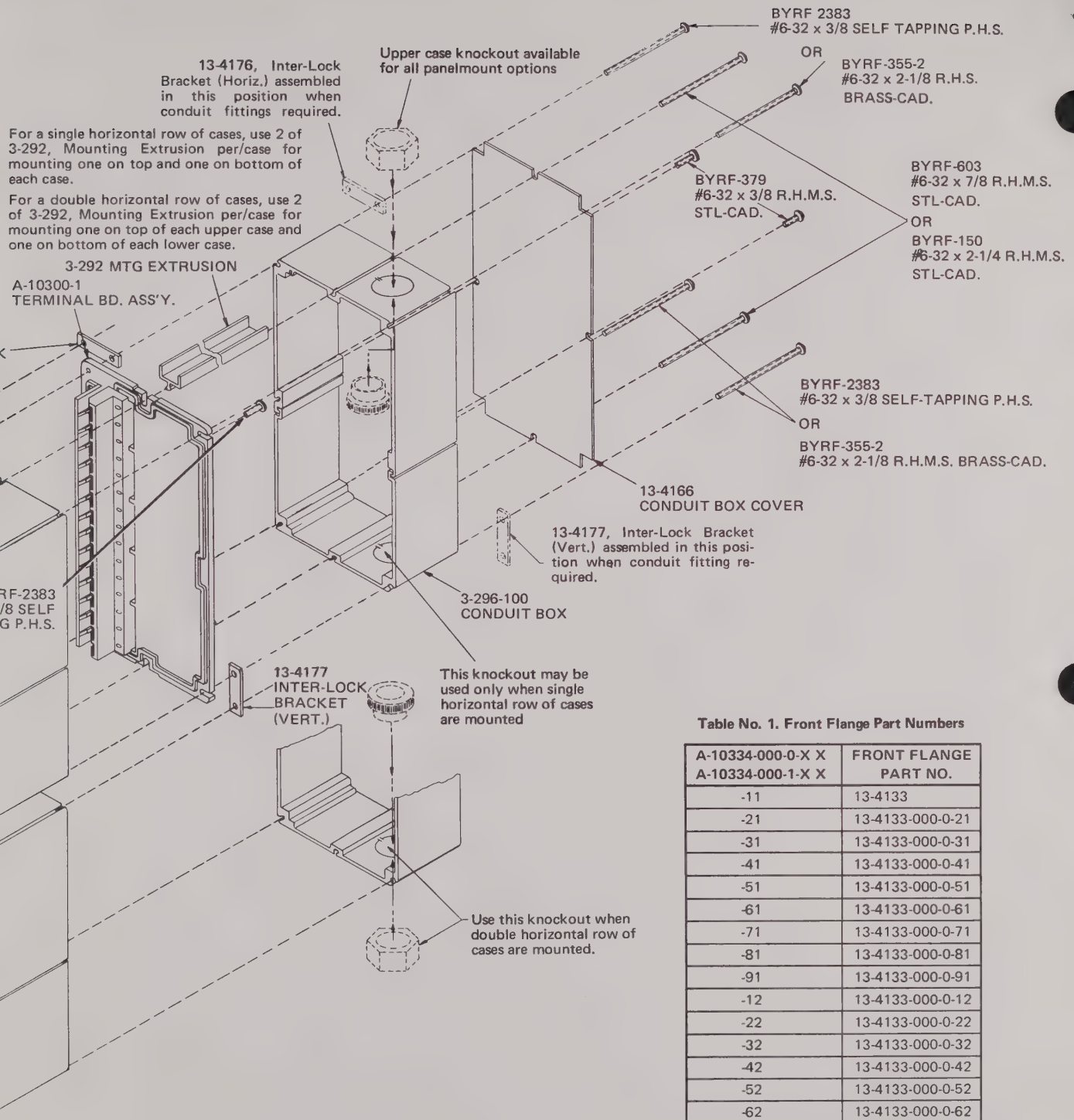

BYRF 2383
#6-32 x 3/8 SELF TAPPING P.H.S.
OR
BYRF-355-2
#6-32 x 2-1/8 R.H.S.
BRASS-CAD.
Upper case knockout available for all panelmount options
13-4176, Inter-Lock Bracket (Horiz.) assembled in this position when conduit fittings required.
For a single horizontal row of cases, use 2 of 3-292, Mounting Extrusion per/case for mounting one on top and one on bottom of each case.
For a double horizontal row of cases, use 2 of 3-292, Mounting Extrusion per/case for mounting one on top of each upper case and one on bottom of each lower case.
BYRF-379
#6-32 x 3/8 R.H.M.S.
STL-CAD.
BYRF-603
#6-32 x 7/8 R.H.M.S.
STL-CAD.
OR
BYRF-150
#6-32 x 2-1/4 R.H.M.S.
STL-CAD.
3-292 MTG EXTRUSION
A-10300-1
TERMINAL BD. ASS'Y.
BYRF-2383
#6-32 x 3/8 SELF-TAPPING P.H.S.
OR
BYRF-355-2
#6-32 x 2-1/8 R.H.M.S. BRASS-CAD.
13-4166
CONDUIT BOX COVER
13-4177, Inter-Lock Bracket (Vert.) assembled in this position when conduit fitting required.
3-296-100
CONDUIT BOX
13-4177
INTER-LOCK
BRACKET
(VERT.)
This knockout may be used only when single horizontal row of cases are mounted
Use this knockout when double horizontal row of cases are mounted.

Table No. 1. Front Flange Part Numbers

A-10334-000-0-X X A-10334-000-1-X X	FRONT FLANGE PART NO.
-11	13-4133
-21	13-4133-000-0-21
-31	13-4133-000-0-31
-41	13-4133-000-0-41
-51	13-4133-000-0-51
-61	13-4133-000-0-61
-71	13-4133-000-0-71
-81	13-4133-000-0-81
-91	13-4133-000-0-91
-12	13-4133-000-0-12
-22	13-4133-000-0-22
-32	13-4133-000-0-32
-42	13-4133-000-0-42
-52	13-4133-000-0-52
-62	13-4133-000-0-62
-72	13-4133-000-0-72
-82	13-4133-000-0-82
-92	13-4133-000-0-92

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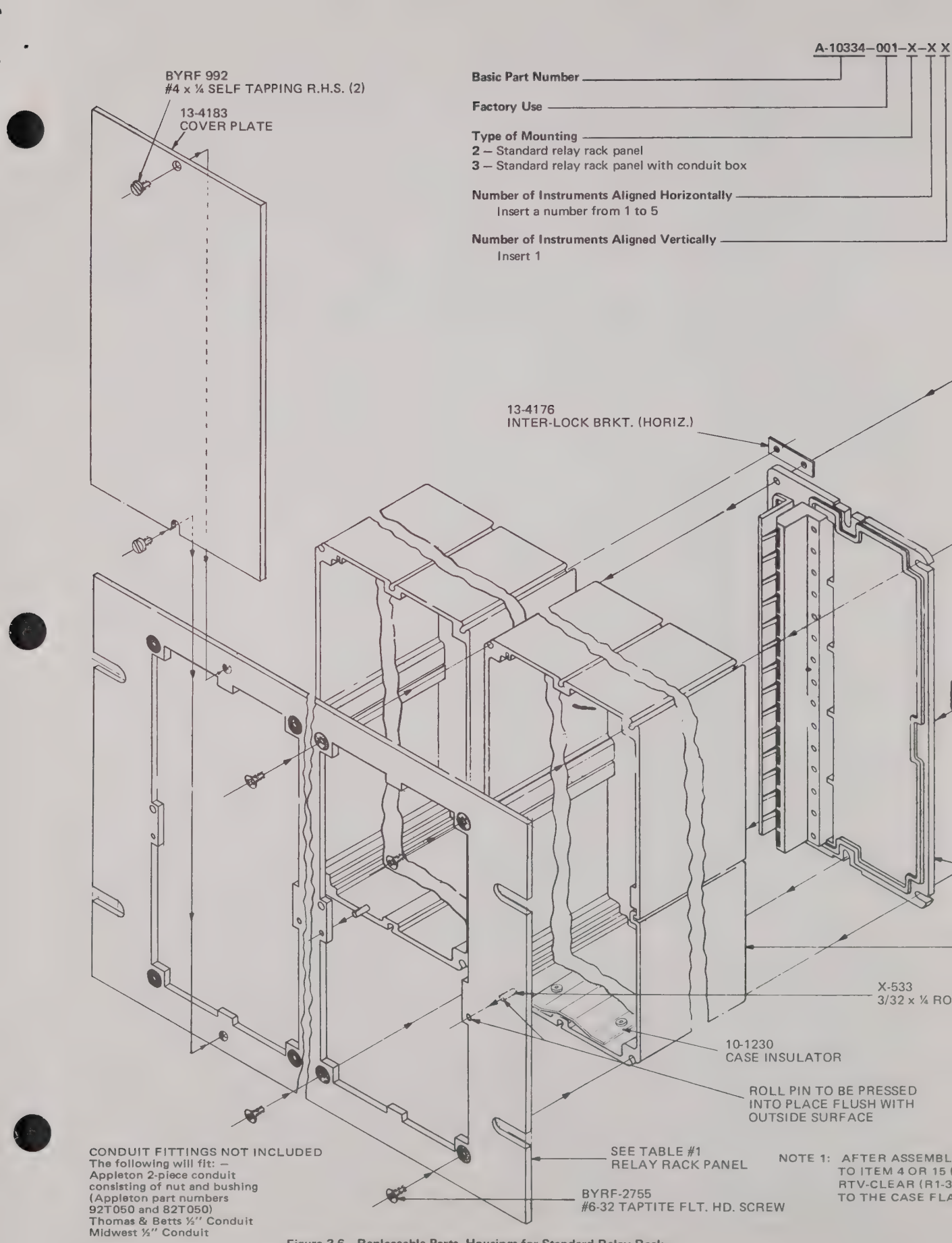


Figure 3-6. Replaceable Parts, Housings for Standard Relay Rack

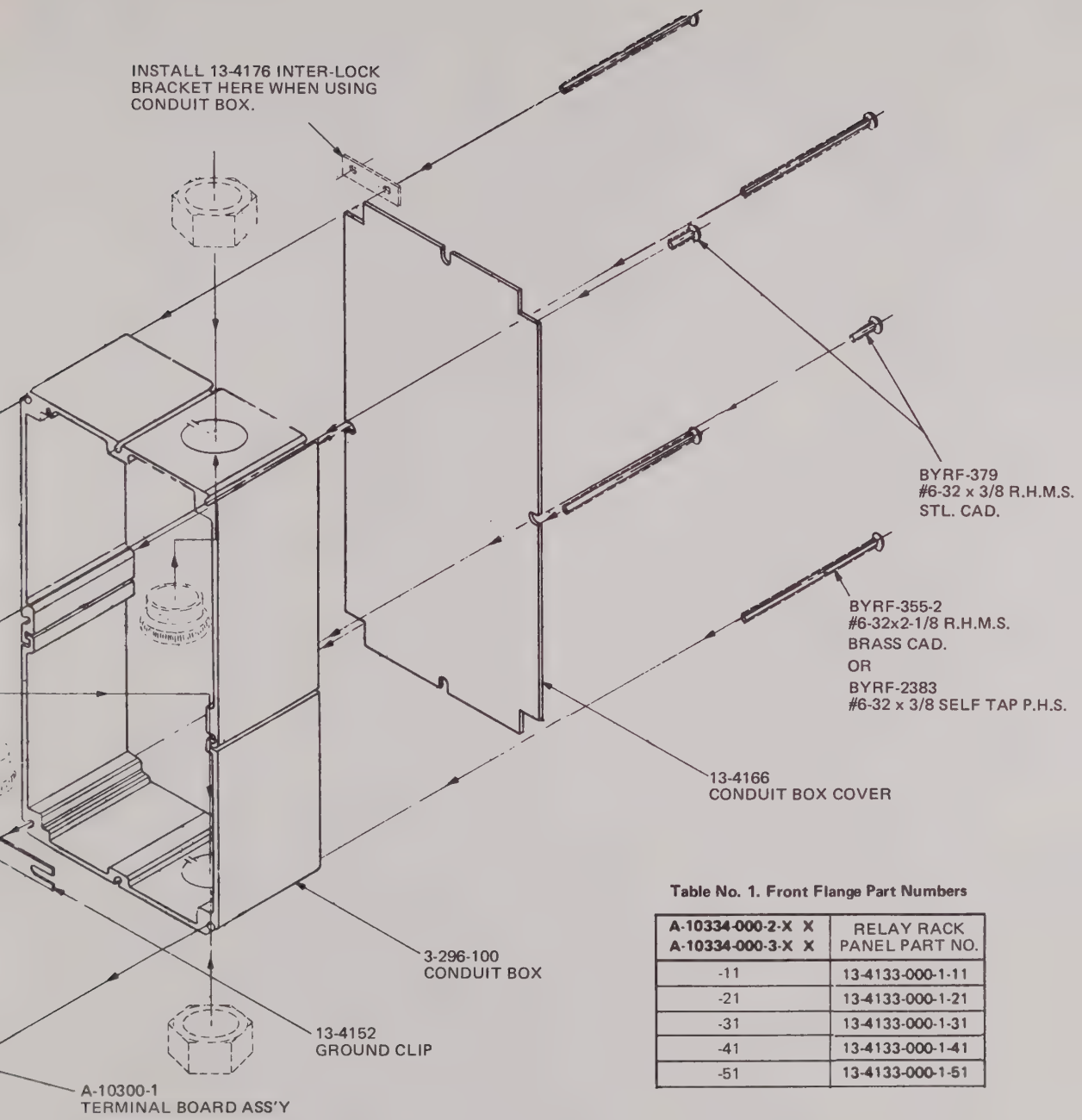


Table No. 1. Front Flange Part Numbers

A-10334-000-2-X X A-10334-000-3-X X	RELAY RACK PANEL PART NO.
-11	13-4133-000-1-11
-21	13-4133-000-1-21
-31	13-4133-000-1-31
-41	13-4133-000-1-41
-51	13-4133-000-1-51

EM 2 (CASE FLANGE)
APPLY A BEAD OF
OUND EACH CASE NEXT
PROVIDING A DUST SEAL.

Series 520
Troubleshooting Main Board and Range Boards, Changing Ranges

5. TROUBLESHOOTING

5.1 General

All of the Controller, except the preamplifier stage of IC1, can be troubleshot with a VOM of 20,000 ohms/volt sensitivity. Do not attempt to make major repairs on the Main Board. Minor repairs such as replacing broken pins may be made. Recalibrate the Main Board if you replace any critical component on it.

When making repairs on printed circuit boards or soldering transistor or integrated circuit terminals, use a 35 watt or less soldering iron and 63/37 or 60/40 resin core solder.

Following is a list of instruments for field troubleshooting the Controller.

Oscilloscope with calibrated sweep or equivalent (required to check waveforms).

Accurate DC Voltmeter

Strip Chart Recorder

In any general troubleshooting procedure, always do paragraph 5.2 first.

5.2 Power Supply Board

Measure all voltage outputs. If any part is replaced the controller must be completely recalibrated.

5.3 Excessive Drift of Either Setpoint or Process Temperature

The drift may be due to thermocouple deterioration. Thermocouple deterioration is usually found in a periodic inspection program. To determine thermocouple deterioration place the test thermocouple as close to the thermocouple under test as possible. If the output of the thermocouple under test differs from what is acceptable by the user (outside his or the manufacturer's specifications) then the thermocouple is defective.

Inspect thermocouple to leadwire and leadwire to controller connections to be certain they are covered properly so that air drafts across them are not affecting temperature indications by causing temperature gradients.

Measure the line voltage. It must be within the specified range.

5.4 Preamplifier IC1 and Range Board

Troubleshooting the Preamplifier stage of IC1 and the Range Board to which it is connected, requires battery operated voltmeters with input impedances of 10M ohms or higher.

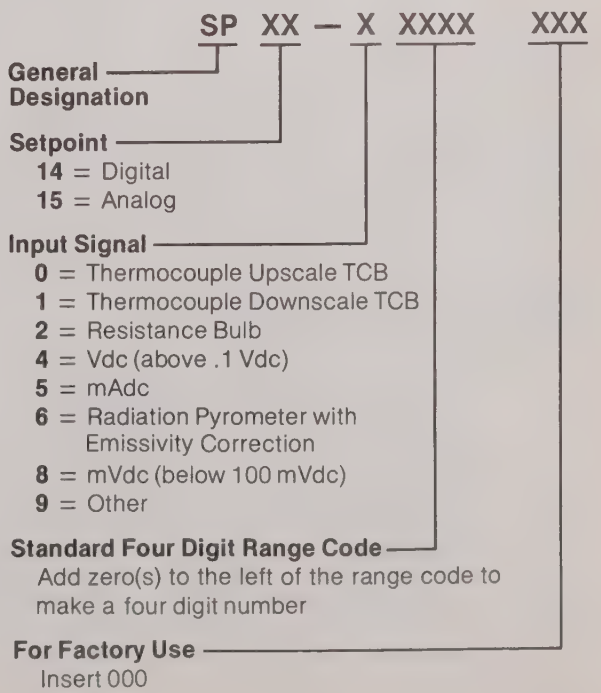
Battery operated test instruments with such an input impedance are the Hewlett-Packard Company Model 427A Multi-Function Meter and the John Fluke Manufacturing Company Model 871AB DC Differential Voltmeter. The remainder of the controller following the DC Amplifier may be troubleshot with a VOM with a 20,000 ohms/volt voltmeter or higher sensitivity.

5.5 Thermocouple Break Check

1. Disconnect any input (TC or dc millivolt source).
2. The Temperature Indicator should go full scale.
3. A milliammeter connected across the current output terminals should indicate zero.

5.6 Range Board Assemblies

Individual components on this assembly should not be replaced. When ordering a complete range board assembly, the following code must be written.


SP XX — X XXXX XXX
General Designation
Setpoint
14 = Digital
15 = Analog
Input Signal
0 = Thermocouple Upscale TCB
1 = Thermocouple Downscale TCB
2 = Resistance Bulb
4 = Vdc (above .1 Vdc)
5 = mAdc
6 = Radiation Pyrometer with Emissivity Correction
8 = mVdc (below 100 mVdc)
9 = Other
Standard Four Digit Range Code
Add zero(s) to the left of the range code to make a four digit number
For Factory Use
Insert 000

STANDARD RANGES FOR DIGITAL SETPOINTS AND FOR ANALOG SETPOINTS WITH SINGLE RANGE TEMPERATURE DIAL DIVISIONS

Thermocouple Ranges

Range	Code Number for Range and Thermocouple Type					
	J	K	R	S	B	Tungsten 5% Rhenium–Tungsten 26% Rhenium*
0–399°F	56					
0–499°F	306					
0–599°F	15					
0–799°F	16					
0–999°F	17	207				
0–1999°F		30	166	316		
0–2999°F			38	36	1814	
2000–3999°F						3382
200–799°F	751					
200–1199°F	203	2411				
500–1499°F	2980	3406				
1300–2299°F		3531				
0–399°C	22					
0–499°C	23					
0–599°C	24	110				
0–799°C		32				
0–999°C		33	276			
0–1999°C					3611	2552
200–1199°C		185	1597	3713		
500–1499°C			521	1395		3719

*No Symbol. Positive Wire is Hoskins Alloy 405. Negative Wire is Hoskins Alloy 426.

J—Iron Constantan K—Chromel Alumel R—Plat 13%
S—Plat 10% B—Plat 30% Rh/Plat 6% Rh

STANDARD RANGES FOR ANALOG SETPOINTS (°F AND °C) WITH DUAL RANGE TEMPERATURE DIAL DIVISIONS

The temperature range listed in column 1 is marked on the inner scale of the dial.

Thermocouple Ranges

Range	Code Number J
0–800°F	231
200–800°F	3644

RESISTANCE TEMPERATURE DETECTOR (RTD) RANGES

(100 ohm Resistance Bulb)

Range	Code
0 to 100°F	3550
0 to 100°C	4039
0 to 200°C	4119
0 to 400°F	1815
0 to 400°C	4022
0 to 600°F	4173
0 to 800°F	2345
200 to 800°F	4174

Range	Standard Millivolt Ranges–Uncompensated
0–9.99mV	381
0–49.9mV	1054
0–99.9mV	2892
–5 to 0 to + 5mV	1324*

*Available only with Analog Setpoint

STANDARD RANGES FOR ANALOG SETPOINTS WITH SINGLE RANGE TEMPERATURE DIAL DIVISIONS

Cryogenic (Low Temperature) Ranges

Range	J	T	100 RTD PT*
–400°F to 0°F	—	—	4164
–300°F to + 300°F	318	545	—
–100°F to + 100°F	—	—	4169

* The RTD range cards are calibrated for the ranges specified and apply to a 100 ohm (at 0°C) platinum element with a temperature coefficient of .00385 ohm/ohm/°C. Consult factory for other ranges and for sensors with other temperature coefficients.

5.7 Changing Ranges

5.7.1 IDENTICAL RANGES

Changing range boards with identical ranges is very easy. Unplug the old range board and plug in the new range board. The new range board is factory calibrated and no calibration is required.

5.7.2 CHANGING FROM ONE SPAN TO ANOTHER WITHIN THE SAME KIND OF RANGE

For example, suppose a 0–399°F range board is replaced by a 0–599°F range board.The digital setpoint will still be effective but only up to 399°F. The setpoint must be modified. Also, the 6 Vdc Process Signal Adjustment and the 3 Vdc Setpoint Voltage Adjustment on the Main Board must be adjusted. Don't forget that any process meter should be replaced.

5.7.3 CHANGING BOTH SPANS AND KINDS OF RANGES

For example, suppose a 0–399°F range board is replaced by a 0–49.9 mV range board. The digital set-

point must be modified. The 6 Vdc Process Signal Adjustment and the 3 Vdc Setpoint Voltage Adjustment on the Main Board must be adjusted. Any process meter scale must be replaced.

5.8 Setpoint Switch Assemblies

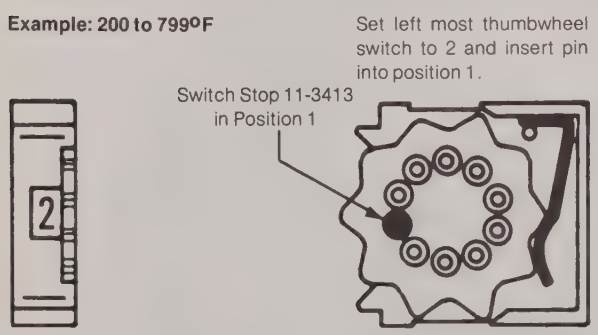
Digits	Part Number	Digital Span
3	A-10342-100	0–X99
3	A-10342-200	200–X99
3	A-10342-300	500–X99
3	A-10342-400	1300–XX99
4	A-10343	0–9999

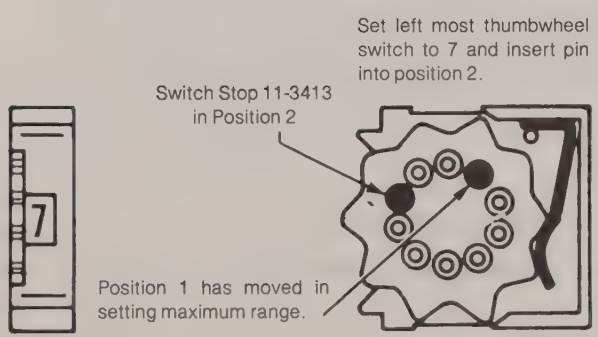
5.9 Modifying a 3-Digit Setpoint Assembly to Change its Range

To install the setpoint assembly, proceed as follows:

1. Hold modules and mounting cover together. Place one of the straps up from the bottom. Place second strap down with the short ends meeting the long ends. Short end should overlap on both sides and snap in place.
2. To set left most thumbwheel switch of the setpoint assembly (hundreds position) to minimum value of the required range, insert switch stop pin (part number 11-3413) into position 1. See example.
3. To set left most thumbwheel switch of the setpoint assembly (hundreds position) to the maximum value of the required range minus one, insert switch stop pin (part number 11-3413) into position 2. See example. Pins are not required for the ranges from 0 to 999.

Example: 200 to 799°F



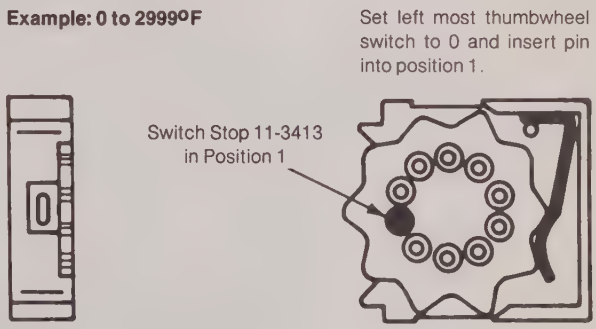

Set left most thumbwheel switch to 7 and insert pin into position 2.
Switch Stop 11-3413 in Position 2
Position 1 has moved in setting maximum range.
7

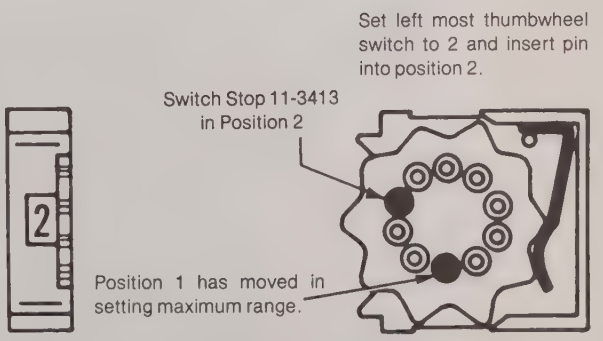
5.10 Modifying a 4-Digit Setpoint Assembly to Change its Range

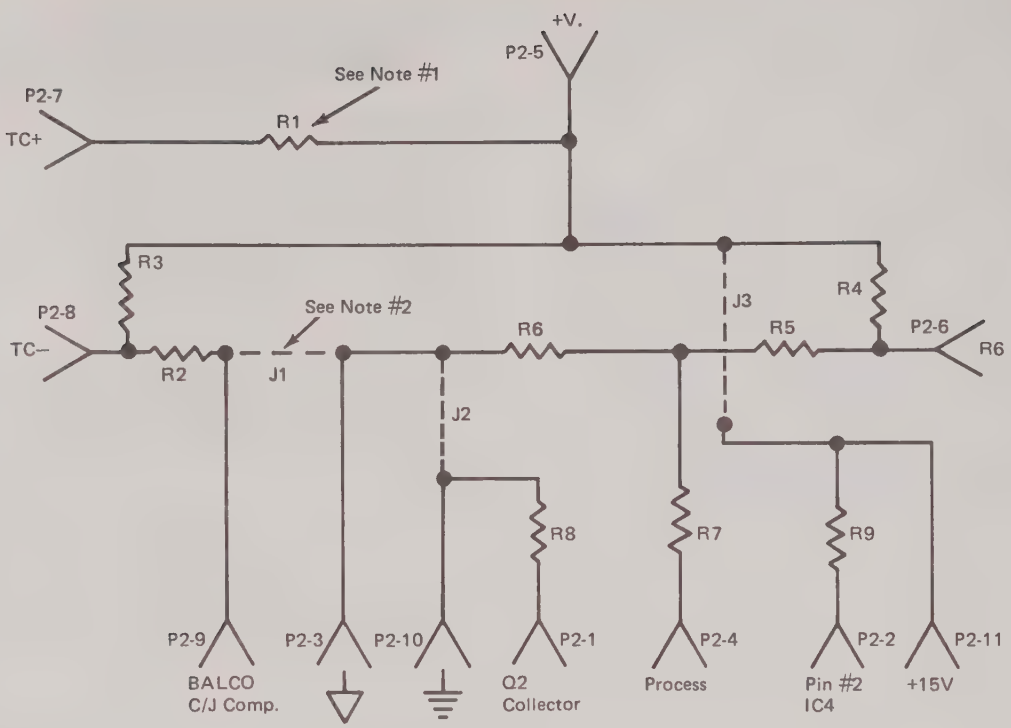
To install the setpoint assembly, proceed as follows:

1. Hold modules and mounting together. Place one of the straps up from the bottom. Place second strap down with the short ends meeting the long ends. Short end should overlap on both sides and snap in place.
2. To set left most thumbwheel switch of the setpoint assembly (thousands position) to the minimum value of the required range, insert switch stop pin (part number 11-3413) into position 1. See example.
3. To set left most thumbwheel switch of the setpoint assembly (thousands position) to the maximum value of the required range minus one, insert switch stop pin (part number 11-3413) into position 2. See example.

Example: 0 to 2999°F



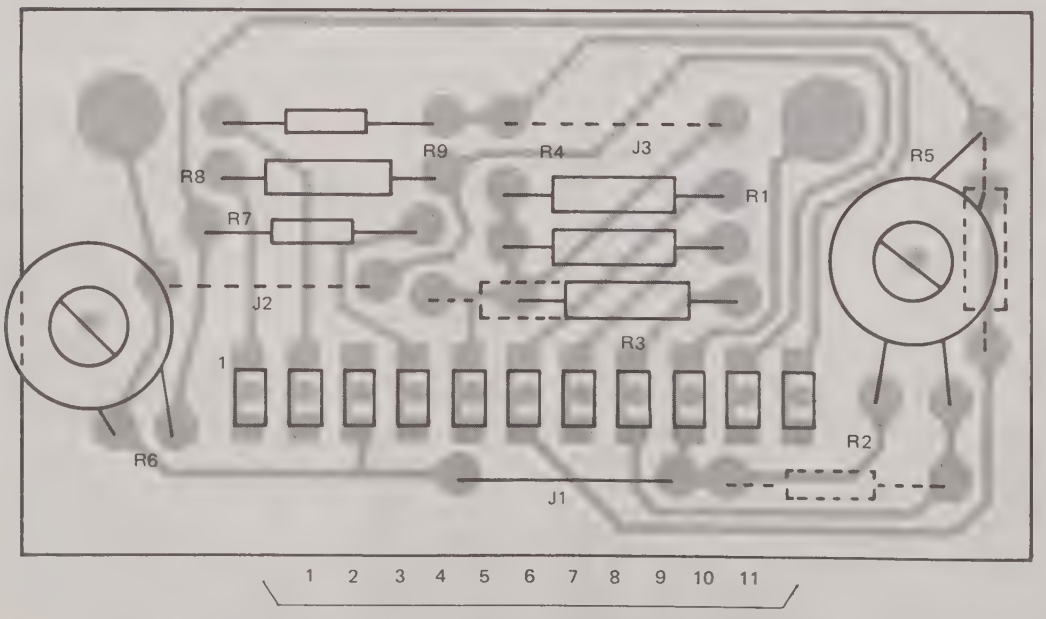

Set left most thumbwheel switch to 2 and insert pin into position 2.
Switch Stop 11-3413 in Position 2
Position 1 has moved in setting maximum range.
2



Notes

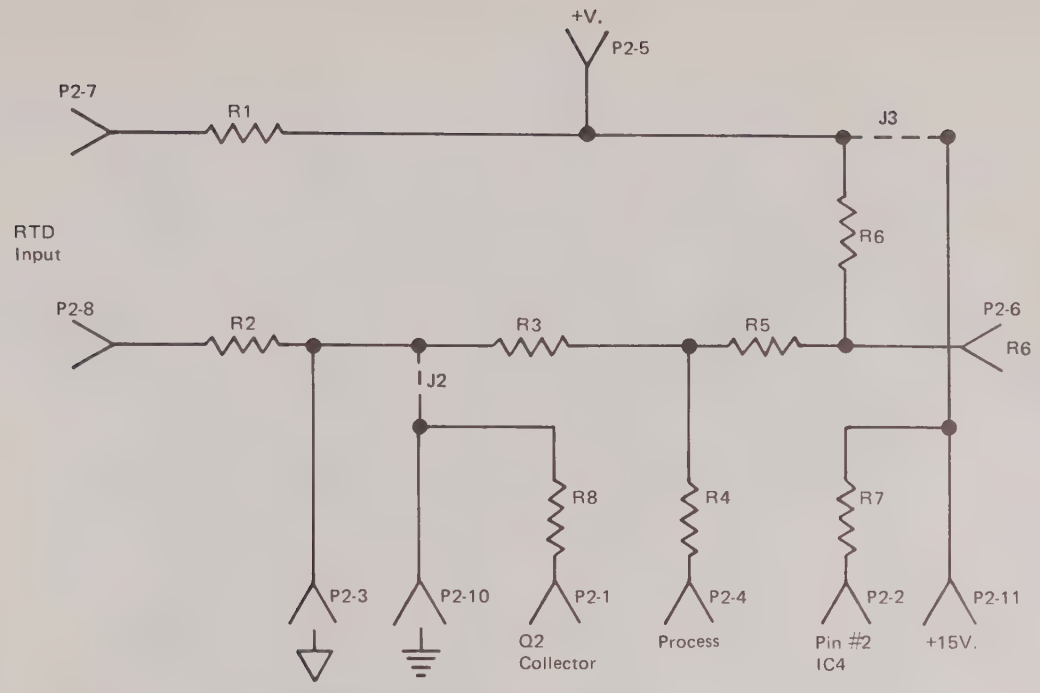
1. R1 is omitted for downscale TCB.
2. J1 is inserted for mV and Type B T/C ranges only.
3. J2 and J3 on SP05 and SP06.
4. R8 and R9 on Digital Setpoints.

R1 is the standard thermocouple break protection resistor. Resistors R2 and R5 set the required millivolt suppression to achieve the 2 to 10 Vdc process signal. R3 determines the current for the cold junction compensation by R2 on the Main Board. R6 and R7 are the preamplifier gain resistors. Resistors R8 and R9 are for span and suppression of the setpoint, respectively.



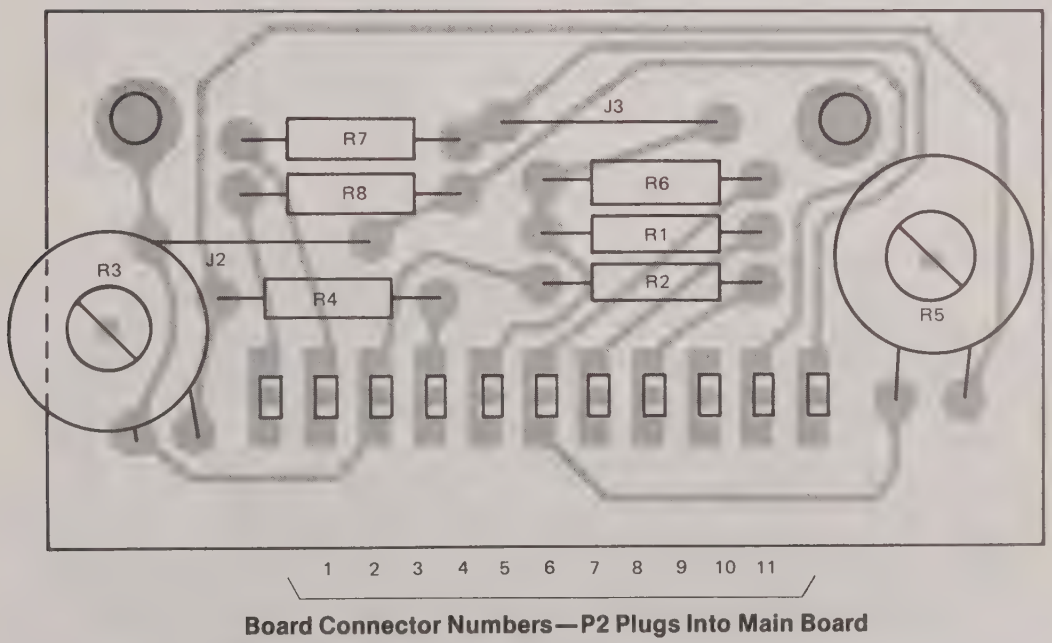
Board Connector Numbers—P2 Plugs Into Main Board

Figure 5-1. Thermocouple and Millivolt Range Board and Schematic



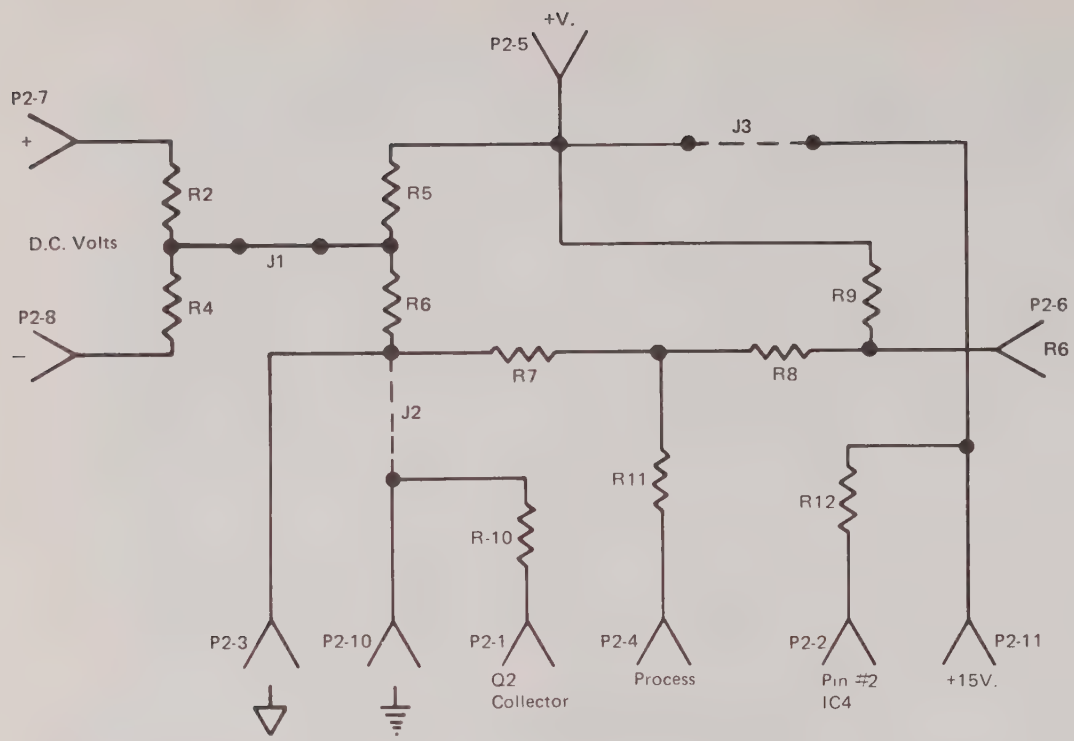
Notes

1. J2 and J3 on SPO5 and SPO6.
2. R8 and R7 on Digital Setpoints



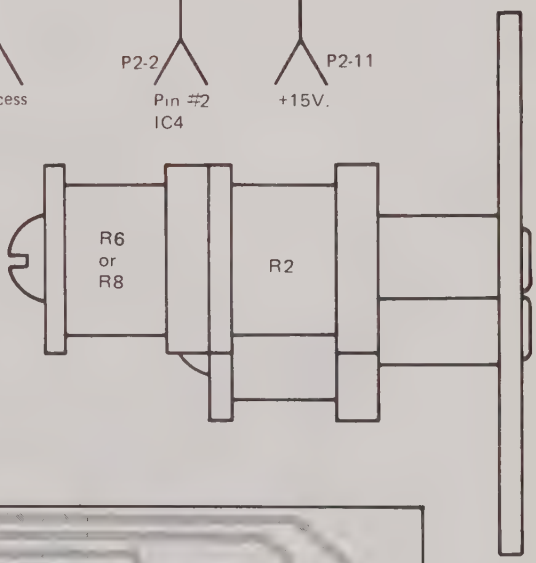
Board Connector Numbers—P2 Plugs Into Main Board

Figure 5-2. Resistance Temperature Detector (RTD) Range Board and Schematic



Notes

1. J2 and J3 on SPO5 and SPO6.
2. R10 and R12 on Digital Setpoints



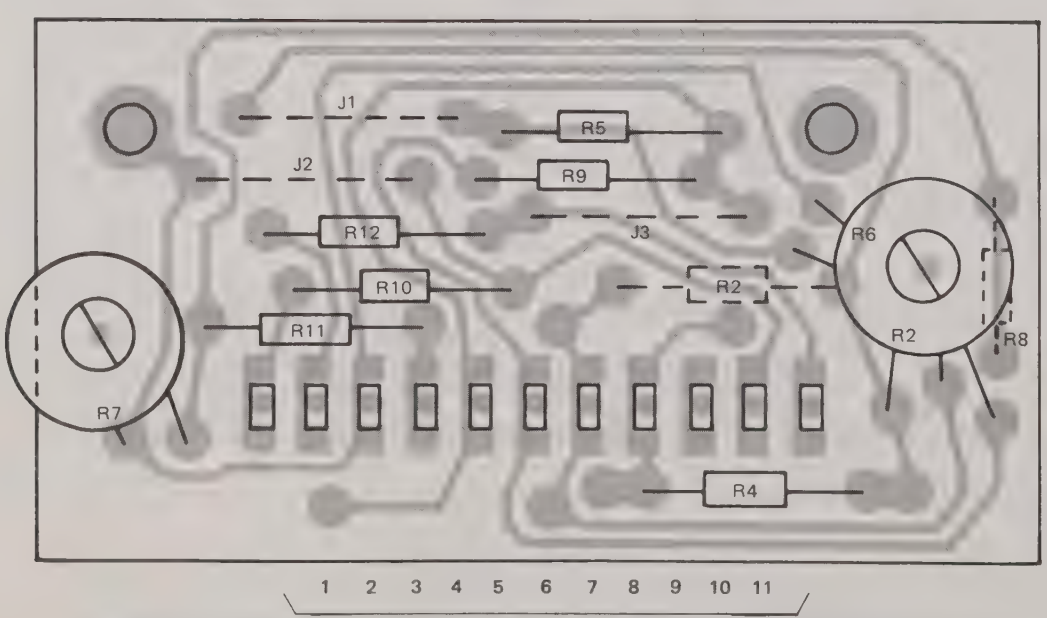
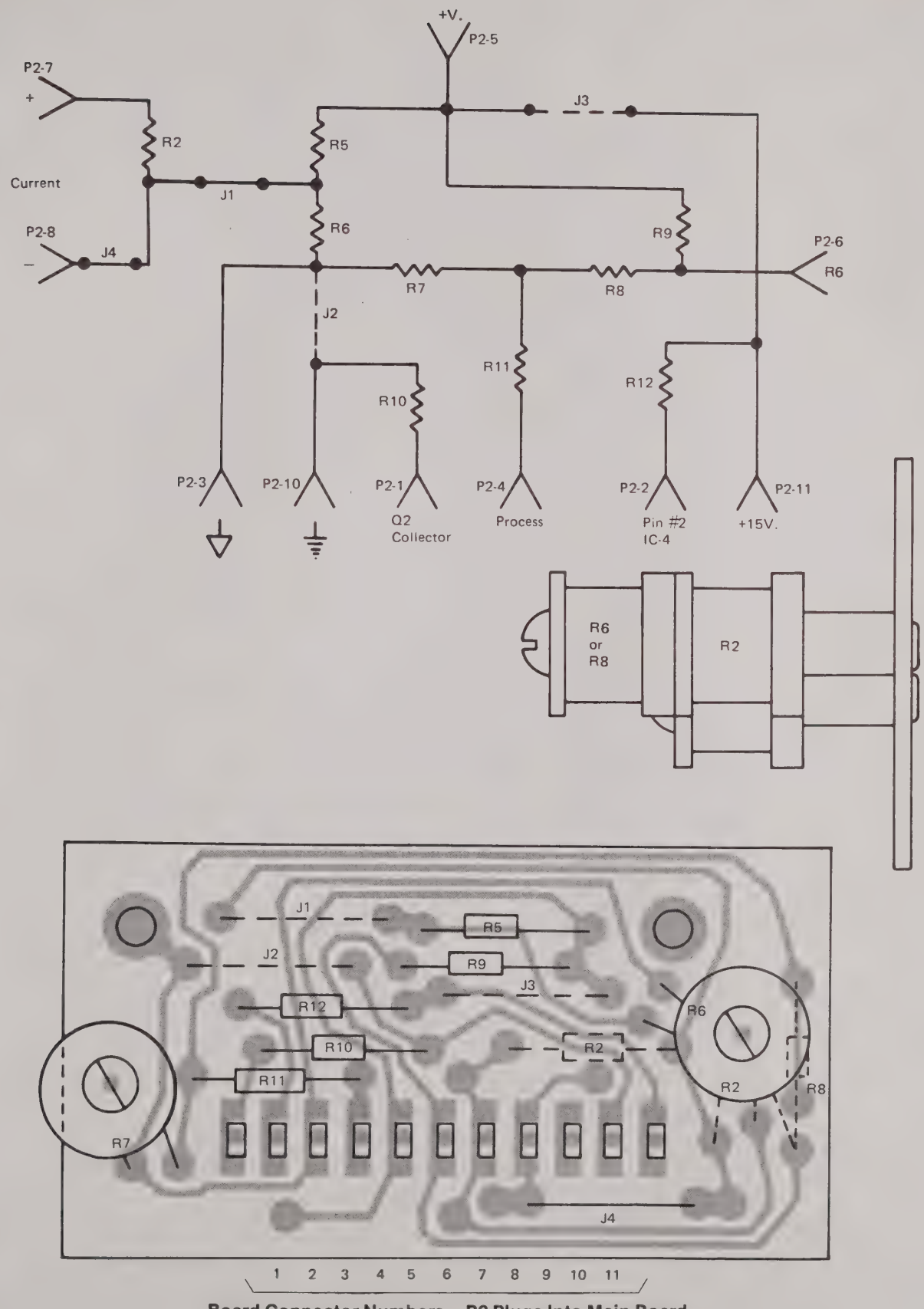


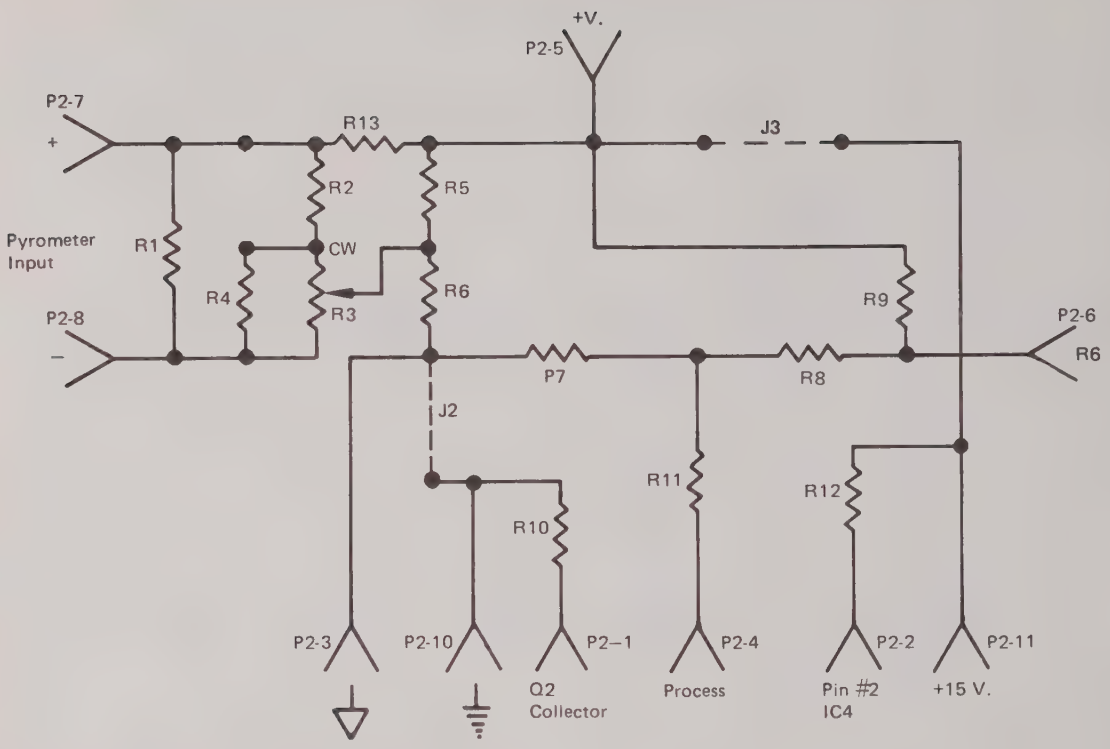
Figure 5-3. Voltage (both above and below .1 Vdc) Range Board and Schematic

Board Connector Numbers—P2 Plugs Into Main Board

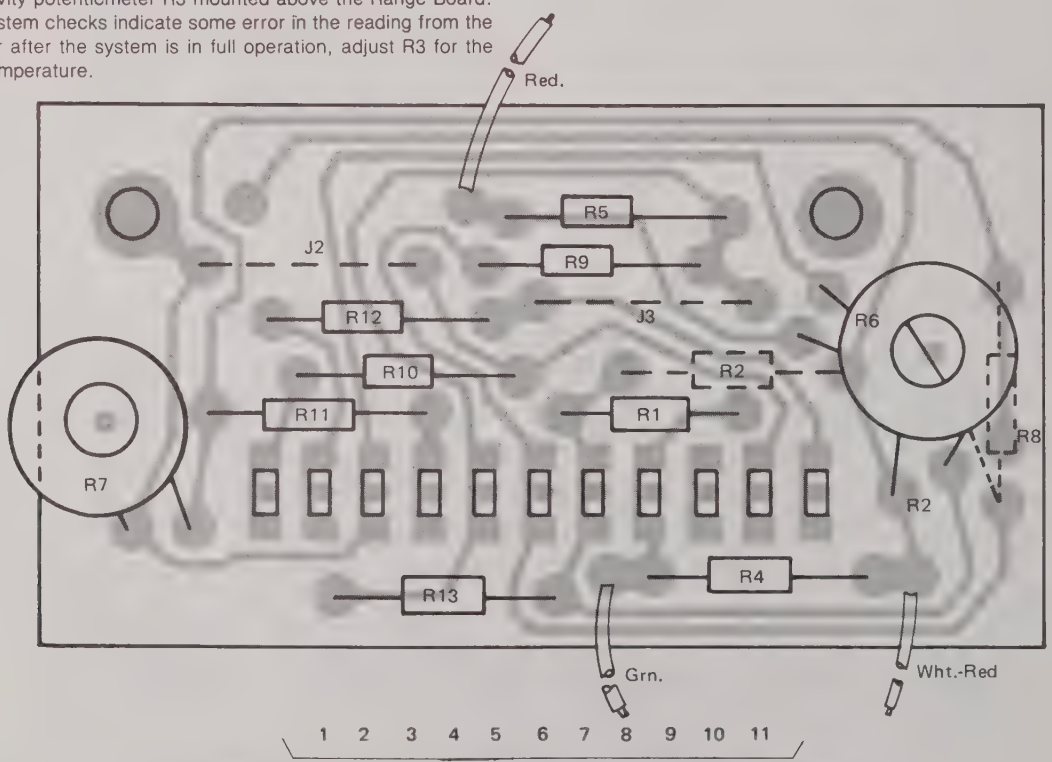


Board Connector Numbers—P2 Plugs Into Main Board

Figure 5-4. Current (mAdc) Range Board and Schematic



To Emissivity potentiometer R3 mounted above the Range Board. Should system checks indicate some error in the reading from the Pyrometer after the system is in full operation, adjust R3 for the correct temperature.



Board Connector Numbers—P2 Plugs Into Main Board

Figure 5-5. Radiation Pyrometer with Emissivity Correction Range Board and Schematic

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INDUSTRIAL INSTRUMENTS DIVISION
1300 Rock Street, Rockford, Illinois, U.S.A., 61101

CIRCUIT DESCRIPTION & SERVICE, HUSKY CONTROL MODE BOARD A-10564-1

7. CONTROL MODE

PROPORTIONAL PLUS INTEGRAL PLUS DERIVATIVE BOARD A-10564-1

7.1 CIRCUIT DESCRIPTION

See Figure 7-1. The Derivative (Rate) Circuit generates a correction signal that is a time derivative of the input signal to the Operational Amplifier (error signal). Since the correction signal is a derivative with respect to time, the Derivative circuit is operative only when the input signal is changing.

The bias of FET Q1A, Q1B and Q2A, Q2B is adjusted by resistor R3. The integral action is generated by R12 and C4. The reset rate is .07 repeats per minute. Field Effect Transistors Q1A, Q1B and Q2A, Q2B are connected in an emitter follower – current source configuration. Emitter follower Q2A has the high input impedance required for long integrating time constants. Emitter follower Q1A has the high impedance required for the long derivative times. Derivative time is 2.7 minutes. The derivative action is generated by R15, C2 and C3.

Reset Inhibition occurs when the demand signal (output of pin 6 of IC5 on the Main Board) on pin 1 goes to the positive limits of the proportional band. The voltage at which inhibition occurs varies with the output control form board. Therefore one of the resistors which establishes the inhibition voltage is located on the output control form board. The resistor number (symbol on the schematic) on the output control form board is R1 on A-10282-100. Inhibition occurs at +8 Vdc on pin 1 of P3. When the limit voltage is exceeded, transistor Q3 turns on, reducing the voltages across R12 and C4 to .6 Vdc.

The effect of the inhibition circuit action is to clamp the integral action to zero when the DEMAND signal exceeds the proportional band. This prevents excessive charge from accumulating on C4 during the time the controller is outside its proportional band. As the process signal again enters the proportional band, the output lowers below 100% and normal circuit action is restored.

7.2 CALIBRATION OF FIELD EFFECT BIAS

Adjustments on the Main Board need not precede this adjustment.

1. Remove the Output Control Form Board from P5.
2. Short pins 1, 2, and 7 of P5 on the Main Board.
3. Place jumper across C4. Place jumper across R15.
4. Connect the precision digital voltmeter from the wiper of R3 to pin 7 of P5.
5. Adjust R3 until 0 Vdc $\pm$.001 Vdc is obtained.
6. Remove the shorting jumpers from pins 1, 2, and 7 of P5. Remove jumpers from C4 and R15. Replace the Output Control Form Board.
7. Allow power to remain on to the instrument and next perform any adjustments, if there are any, for the Output Section of this manual.

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1300 Rock Street, Rockford, Illinois, U.S.A., 61101

January, 1976

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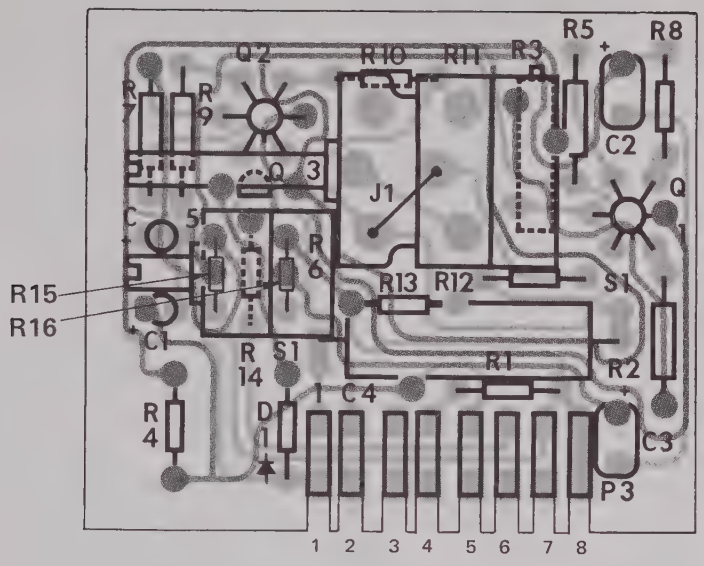
Table 7-1. Parts List, Proportional plus Integral plus Derivative Board A-10564-1

Symbol	Part Number	Description
	CAPACITORS	
C1,C5	39-410	4.7 μ F, 20%, 20 WVDC
C2,C3	39-442	4.7 μ F, 20%, 20 WVDC (selected)
C4	39-423	10 μ F, 20%, 50 WVDC
	DIODE	
D1	EYZP-384	250 PIV, I_f = 100 mA
	TRANSISTORS	
Q1,Q2	31-157	2N3956, Factory selected dual FET
Q3	EYZP-623	2N4126
	RESISTORS	
Resistors are 10% tolerance, 1/4W, unless stated otherwise.		
R1	CYZR-481-300	220 ohms
R2	CYZR-862-201	1k ohms, 1%
R3	29-390	Variable, 1k ohms, 10%, 3/4W
R4,R13	40-1847	47k ohms
R5,R7,R9	CYZR-862-218	1.5k ohms, 1%
R8,R10,R14	40-1314	100k ohms
R12	40-1983	82M ohms, 1/2W
R15	40-847	68M ohms, 1/2W
R16	40-1858	6.8M ohms
	ROTARY SWITCH	
S1		SPDT, Part of R6



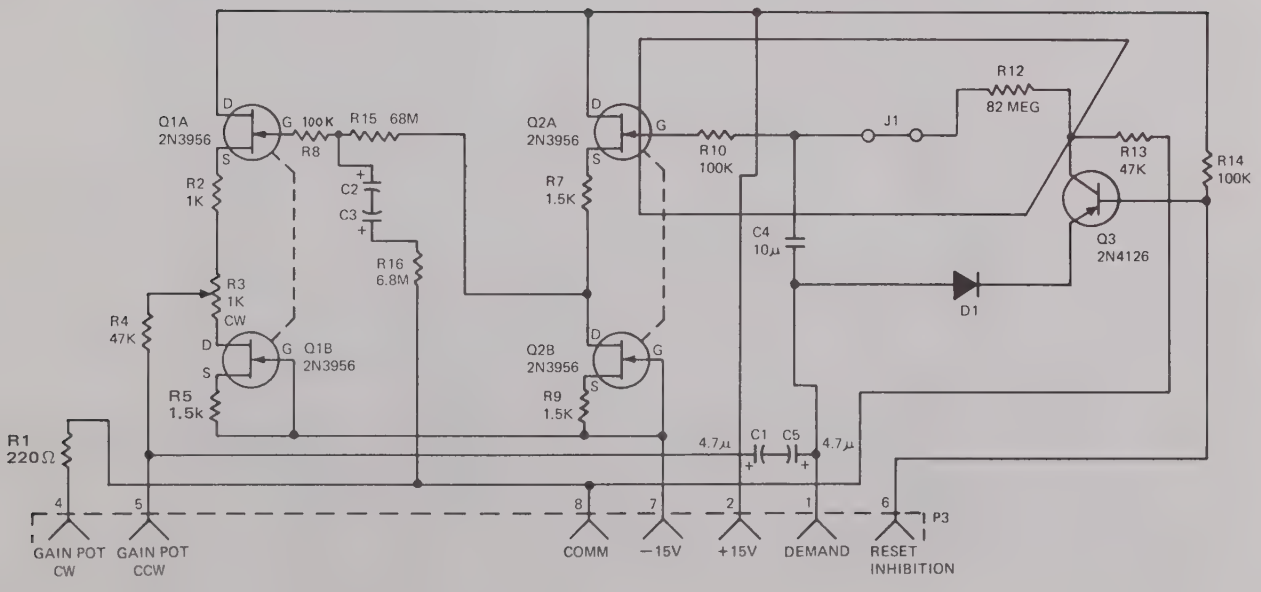
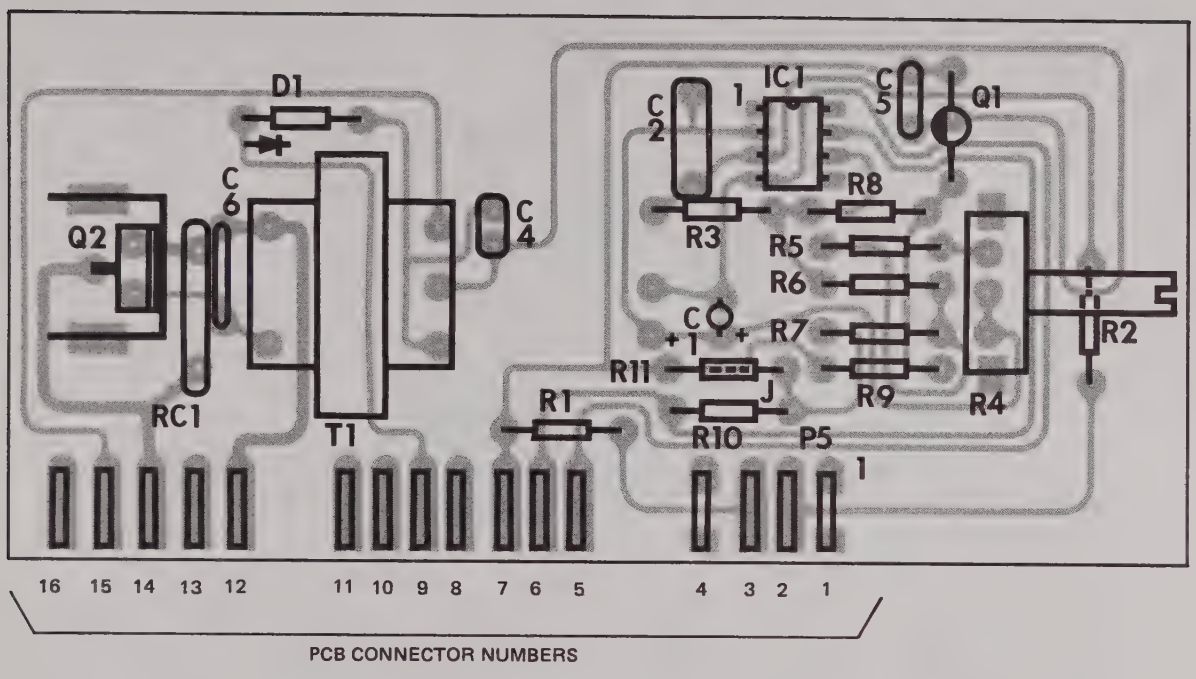


Figure 7-1. Proportional plus Integral plus Derivative Board A-10564-1 and Schematic

Table 8-1. Parts List, Single Time-Proportioning Solid State Switching Output Board A-10282-103

Symbol	Part Number	Description
	CAPACITORS	
C1	39-382	1 μ F 20%, 35 WVDC
C2	CYZR-803	.1 μ F 20%, 250 WVDC
C4	39-076	250 ρ F 20%, 500 WVDC
C5	39-063	.001 μ F, GMV, 600 WVDC
C6	39-325	.05 μ F 20%, 100 WVDC
	DIODE	
D1	EYZP-384	250 PIV, I_f = 100 mA
	INTEGRATED CIRCUIT	
IC1	31-1012	741C Operational Amplifier
	TRANSISTORS	
Q1	31-082	2N3416
Q2	31-155	Triac, Factory Selected. Either RCA 40669 or GE SC 146D
	RESISTORS	
Resistors are 10% tolerance, 1/4W, unless otherwise stated.		
R1	CYZR-861-434	221k ohms, 1%, 1/8W, 100 PPM
R2	CYZR-861-388	80.6k ohms, 1%, 100 PPM
R3	CYZR-861-408	118k ohms, 1%, 100 PPM
R4	29-373	Cycle pot, 2M ohms 30%, 1/5W
R5	40-1917	180k ohms
R6	CYZR-861-326	18.2k ohms, 1%, 100 PPM
R7	CYZR-862-348	30.9k ohms, 1%, 100 PPM
R8	40-1950	22k ohms
R9	40-1842	1.8k ohms
R10	CYZR-861-224	1.74k ohms, 1%, 1/8W, 100 PPM
R11	CYZR-861-243	2.74k ohms, 1%, 1/8W, 100 PPM
RC1	50-1196	Suppressor
	TRANSFORMER	
T1	30-323	Pulse



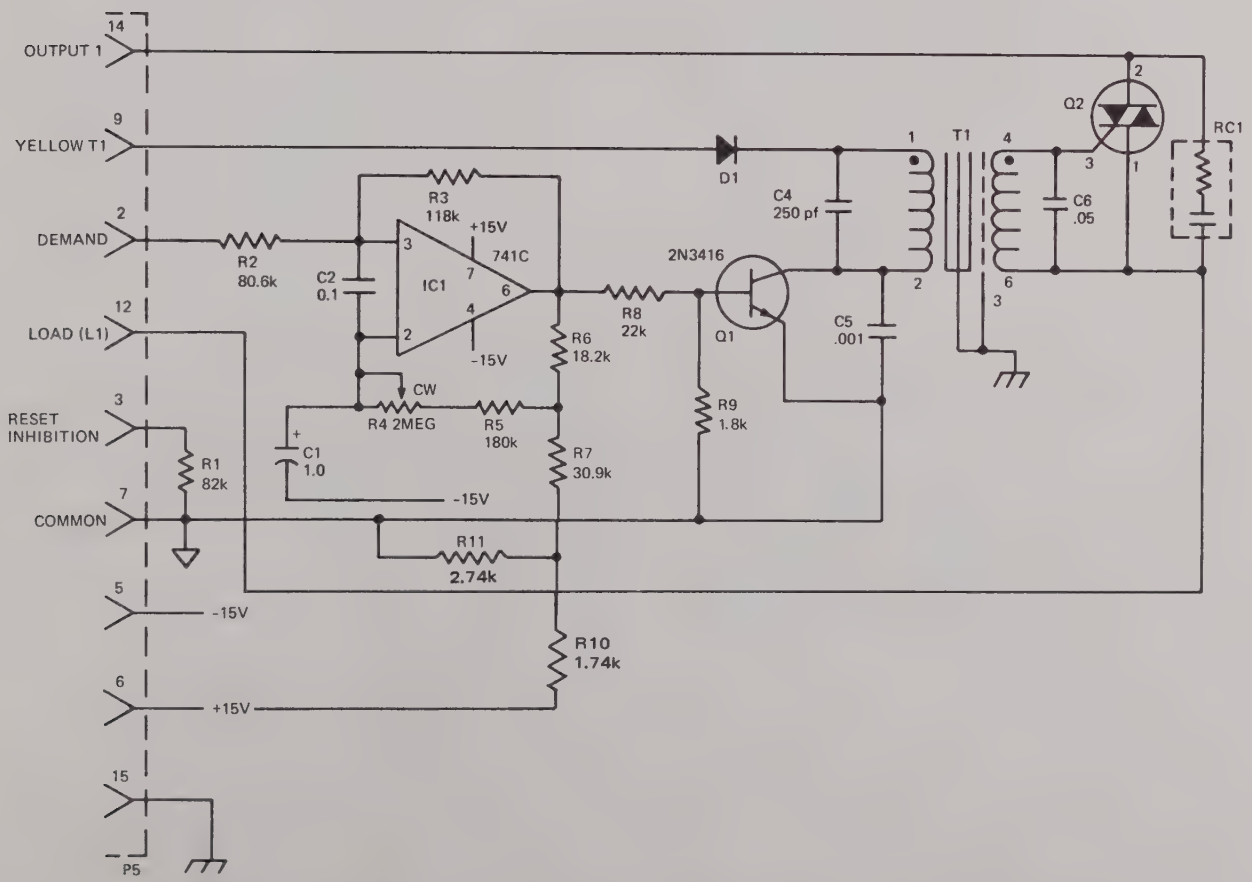


Figure 8-2. Single Time-Proportioning Solid State Switching Output Board A-10282-103 and Schematic

SERIES 520
CIRCUIT DESCRIPTION & SERVICE, HUSKY OUTPUT BOARD

SINGLE TIME-PROPORTIONING SOLID STATE SWITCHING OUTPUT BOARD A-10282-103

8. OUTPUT CONTROL FORM

8.1 GENERAL

The circuit description, calibration and troubleshooting for the Output Control Form Board for the Model 524B follows in paragraphs 8.2, 8.3 and 8.4.

8.2 CIRCUIT DESCRIPTION

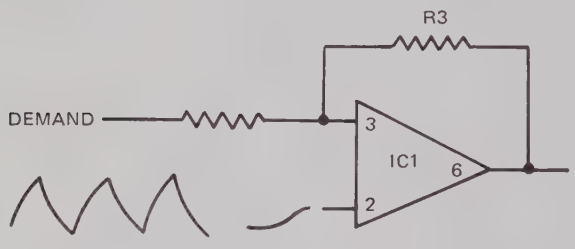


Figure 5-1. Triangular Waveform

See Figures 8-1 and 8-2. The demand signal on pin 2 of P5 is compared with a voltage with a triangular waveform. This waveform is generated by C1, R4, and R5, and appears between terminal 2 of IC1 and the -15 Vdc on pin 5 of P5. When the Demand Signal on pin 3 of IC1 exceeds the maximum amplitude of the waveform the output of IC1 on pin 6 approaches the potential of the +15 Vdc supply, causing Q1 to turn on, and allowing the gate signal to turn Q2 on. The rating of Q2 is 1A continuous, 10A inrush, 30 mA minimum. When the Demand Signal is less than the minimum amplitude of the waveform (the condition calling for no power to the load), the potential on pin 6 of IC1 approaches -15 Vdc, causing Q1 and Q2 to turn off.

Fuse F1 on the Main Board is in series with Triac Q2. The fuse is rated 2A at 250 Vac. Fuse size must not be exceeded. The copper foil on the Main Board will be destroyed at higher currents.

8.3 CALIBRATION

8.3.1 General

The front panel CYCLE control is the only adjustment on this output board.

8.3.2 Obtaining a Faster Cycling Time

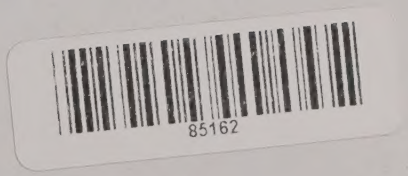
Potentiometer R4 is set to obtain a cycle time from .6 to 6 seconds nominal.

8.4 TROUBLESHOOTING

For an overall inspection of this board, proceed as follows:

1. Connect a load that requires a current of 50 mAdc or more. The front panel Amber lamp will not turn off unless the load has this minimum current.
2. Connect a dc millivolt source to controller rear panel input terminals 1 and 2. Be certain the polarity of the connections is correct. Adjust source for equivalent of midscale temperature.
3. Place jumper across C4 and place jumper across R15 on control mode Board A-10514.
4. Turn power on to the controller.
5. Turn the GAIN control fully CCW.
6. Turn the SETPOINT ADJUST control to midspan.
7. The front panel Amber lamp should be dark.
8. Turn the SETPOINT ADJUST control to full scale.
9. The Amber lamp should be on 50% of the time and should glow steadily.
10. Adjust the millivolt source for the equivalent of zero scale. Allow the SETPOINT ADJUST control to remain at full scale.
11. The Amber lamp should be on 100% of the time.

Do not depend on the fuse F1 on the Main Board to protect Triac Q2, the primary purpose of the fuse is to protect the copper foil on the Main Board.



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